COLOR TELEVISION

HEARINGS

BEFORE THE

COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE HOUSE OF REPRESENTATIVES

EIGHTY-THIRD CONGRESS

FIRST SESSION

ON

THE PRESENT STATUS OF COLOR TELEVISION

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COLOR TELEVISION

TUESDAY, MARCH 24, 1953

HOUSE OF REPRESENTATIVES,
COMMITTEE OF INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The committee met, pursuant to call, at 10 a. m., in room 1334, New House Office Building, Hon. Charles A. Wolverton (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

I wish to express on behalf of the committee our very great gratification at the spirit with which these hearings have been received and responded to by interested parties. There has been a unanimity of desire upon the part of those who are best qualified to speak on this subject to participate with the committee in this study that it is about to commence, which is of such great importance to the public.

Prior to hearing the first witness, I have an introductory statement that I would like to make, particularly for the record and for the benefit of the members of the committee. It deals in its own logical way with the subject of color television. While it is a bit lengthy as a statement from the chairman, nevertheless it contains information that I think will be very helpful to us as the hearings proceed.

This morning the Committee on Interstate and Foreign Commerce will begin its hearings and investigation into the present status of color television. The purpose of these hearings is to get, if possible, a definite answer to the question, When will color television become a reality in the homes of the American people? In order to give the members of this committee and the public a better understanding of the issues now confronting the industry and the Government, I deem it appropriate to outline, briefly, the history of color television in the United States up to the present time.

Color television and black and white television are not separate developments. Color and black and white television developed side by side. As a starting point for both, therefore, it is appropriate to mention the date of February 29, 1940. On that day, the Federal Communications Commission adopted rules permitting limited commercial operation of experimental television stations.

The date of January 27, 1941, is an important one in the development of color television. On that date the Federal Communications Commission received a report from an industry committee, the National Television Standards Committee (commonly referred to as NTSC) on television standardization in the very high frequency band (docket 5806). In the report, five American color television systems were analyzed. All of these were intended to operate within a 6-megacycle band.

One month later, on February 27, 1941, the Commission issued a public notice setting forth alternative standards for black-and-white and color television. In the course of the ensuing hearing, several color systems were demonstrated to the Commission. Following these hearings, on April 30, 1941, the Commission adopted black and white television standards, and the operation of commercial television stations was authorized beginning July 1, 1941. In the accompanying report, the Commission stated that color television required further field testing, and recommended that experimental color television programs be transmitted by television broadcast stations.

On April 9, 1942, the Commission held an informal conference with the industry on television problems under wartime conditions. The industry informed the Commission that the demands of the national emergency had prevented the industry from proceeding with color television experimentation to the extent that would have been possible in normal times, and as a result definite conclusions could not be presented.

Also during the year 1942, the manufacture of television sets was discontinued and the manufacture was not resumed until 1946. Between 1940 and 1942, some 3,000 television sets had been placed in the hands of the public.

The Federal Communications Commission resumed its activities in the field of television, both black and white and color, which had been interrupted by World War II, by conducting between September 28 and November 2, 1944, hearings on general allocation of frequencies (Docket 6651). In the course of these hearings, the Radio Technical Planning Board recommended to the Commission that adequate standards for color television for a 6-megacycle channel could not be established at that time, and that experimentation should be continued.

Following these hearings on May 25, 1945, the Federal Communications Commission issued a report allocating 13 channels (later reduced to 12 channels) for commercial television broadcasts. Each channel was 6 megacycles wide and all of the channels were located in the very-high-frequency band. Space was set aside, however, by the Commission in the ultra-high-frequency band between 480 and 920 megacycles for experimental television broadcasts, both in black and white and color.

On September 27, 1946, Columbia Broadcasting System petitioned the Federal Communications Commission to promulgate commercial color television standards. The standards proposed by Columbia Broadcasting System required a channel 16 megacycles wide. The Commission held hearings on Columbia Broadcasting System's petition between December 3, 1946, and February 13, 1947. In the course of the hearings, the Radio Corporation of America demonstrated a color television system requiring a band 14.5 megacycles wide. However, the Radio Corporation of America did not request the adoption of standards for the operation of that system.

On March 18, 1947, the Federal Communications Commission issued its report denying Columbia Broadcasting System's petition on the ground that the proposed system had not been adequately field tested, and that the possibility of other color television systems requiring a narrower band width had not yet been fully explored.

In 1946 the industry resumed the production of black and white

television receivers. The number of sets produced jumped from approximately 5,000 during 1946 to about 178,500 in 1947.

Color television was again explored by the Federal Communications Commission on September 20–23, 1948, for the purpose of securing information on the development of black and white and color television in the ultra-high frequency band (Docket 8976). The testimony presented in the course of these proceedings showed that progress was made by the industry in the development of color systems using 6-megacycle channels. However, the Joint Technical Advisory Committee, sponsored by the Radio Manufacturers' Association and the Institute of Radio Engineers, reported that it was impractical at that time to set up commercial standards for color television.

On September 30, 1948, the growth of television in the United States came to a temporary halt when the Federal Communications Commission published its freeze order on the issuance of new television station licenses.

During the year 1948 the industry produced approximately 975,000 television receivers. Thus, the total number of sets produced by the end of 1948, most of which were in actual use, had reached the number of 1,162,000.

Between September 26, 1949, and May 26, 1950, the Federal Communications Commission held extensive hearings on color television which included demonstrations of color television systems suggested by Radio Corp. of America, Columbia Broadcasting System, and Color Television, Inc. During 1949 while the Commission's color television hearings were in progress the industry produced approximately 3,000,000 black and white receivers. Thus, by the end of 1949, the total number of black and white receivers produced in the United States reached 4,162,000.

On September 1, 1950, the Federal Communications Commission issued its First Report on Color Television Issues. The report accepted the color television standards proposed by Columbia Broadcasting System. However, the Commission suggested in its report that it would be in a position to postpone the final adoption of these standards if a sufficient number of manufacturers of television receivers would agree to adopt so-called bracket standards, and would agree to build the majority of television receivers in accordance with such standards. The purpose of the bracket standards was to assure that the majority of receivers built in the future by the industry would be capable of receiving in black and white, in addition to standard black and white broadcasts, the color broadcasts using the proposed Columbia Broadcasting System's standards. On the other hand, the Commission stated that if a sufficient number of manufacturers would not give that assurance, the Commission felt compelled to adopt finally the color standards proposed by Columbia Broadcasting System.

As of September 1, 1950, when the Commission issued its First Report on Color Television Issues, the number of black and white receivers in use had reached the figure of approximately 7 million. During the year 1950 the industry produced approximately 7.5 million television receivers, so that the total number of receivers which had been produced by the end of 1950 reached the figure of 11,600,000. Of this number, an estimated 10,500,000 were in actual use. The difference is accounted for by new sets in the hands of dealers and old sets discarded by the public.

Having received unfavorable replies from the majority of manufacturers of television sets on the proposed bracket standards, the Commission, on October 11, 1950, issued its Second Report on Color Television in which the Commission finally adopted the engineering standards for color television proposed by Columbia Broadcasting System.

On the same date the Commission denied a petition which had been filed on October 4, 1950, by Radio Corp. of America, requesting the Commission, before making a final determination with respect to color standards, to review improvements made in its system by Radio Corp. of America, and to permit, until June 3, 1951, experimental color broadcasts under all systems so far demonstrated to the Commission or under any new system that might be developed.

On October 17, 1950, Radio Corp. of America brought suit in the Federal district court in Chicago to enjoin and set aside the order of the Federal Communications Commission of October 11, 1950, in which the Commission adopted the color standards proposed by Columbia Broadcasting System. Arguments on the petition were heard before a three-judge court, and on December 22, 1950, the court, by a vote of 2 to 1, upheld the order of the Federal Communications Commission. However, the court decided to continue in effect until April 1, 1951, or until terminated by the Supreme Court, a restraining order issued at an earlier date by the Federal district court in Chicago. On May 28, 1951, the Supreme Court upheld the Commission's order on color television standards, and dissolved the temporary restraining order.

On June 25, 1951, the Federal Communications Commission announced that all regular television stations were permitted to broadcast color programs in accordance with the standards adopted by the Commission.

On November 20, 1951, another Government agency—the National Production Authority—entered the picture. It issued an order, designated as Order M–90, prohibiting the manufacture of color television sets for general sale for home use. The National Production Authority stated that this order was necessary in order to prevent the diversion of strategic materials, technically trained personnel, and production facilities from the manufacture of scarce items for the defense program. The order was modified on June 24, 1952, so as to authorize, under certain conditions, the manufacture and assembly of color television receivers for home use provided permission was first obtained from the National Production Authority.

During the years 1951 and 1952, the industry produced approximately 5,400,000 and 6,000,000 black and white television receivers respectively. This brought the total of television receivers produced in the United States between 1940 and 1952 to a figure of over 23,000,000. Deducting from that figure sets in the hands of dealers and discarded old sets, it has been estimated that by the end of 1952 approximately 21,200,000 black and white receivers were in actual use. This number continues to grow, and one of the latest estimates gives the figure of black and white receivers in actual use as in excess of 21,500,000.

I have given you a brief outline of the history of color television. I also have given you a year-by-year account of the number of black and white receivers produced and in the hands of the public. I be-

lieve this information is indispensable to an understanding of the issues now facing the Government and the industry in the field of color television.

I think it would be appropriate to hear now from our first witness this morning and to have him give us his evaluation of the present status of color television. Before doing so, however, it is also appropriate, in my opinion, to read into the record some correspondence that has taken place between the chairman of this committee and Mr. McCoy, Acting Administrator of the National Production Authority, under date of March 17, 1953.

I addressed this communication to Mr. McCoy under date of March 17, 1953:

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D. C., March 17, 1953.

Mr. H. B. McCOY,
Acting Administrator, National Production Authority,
Washington 25, D. C.

DEAR MR. McCOY: The Committee on Interstate and Foreign Commerce will commence hearings on March 24, 1953, to determine the present status of color television. In connection with these hearings, I shall appreciate receiving from the National Production Authority a statement setting forth the conditions which prompted the issuance of the NPA order suspending the manufacture of color television sets, and what consideration, if any, is being given by the authority to rescinding this order.

I shall appreciate your giving this request your immediate attention.

Sincerely yours,

CHARLES A. WOLVERTON, *Chairman.*

In reply to that letter I received this communication:

DEPARTMENT OF COMMERCE,
NATIONAL PRODUCTION AUTHORITY,
Washington 25, March 20, 1953.

HON. CHARLES A. WOLVERTON,
Chairman, Committee on Interstate and Foreign Commerce,
House of Representatives, Washington, D. C.

DEAR CONGRESSMAN WOLVERTON: This is in response to your letter of March 17, 1953, in which you make inquiry regarding NPA Order M-90 which has to do with color television.

This order was originally issued on November 20, 1951, and was a sequel to discussions held in October by Charles E. Wilson, then Director of the Office of Defense Mobilization, and Manly Fleischmann, then NPA Administrator, with representatives of the television industry. The order was designed to conserve the strategic materials, technically trained personnel and production facilities which were capable of being used in the production of color television for entertainment purposes. Its purpose and effect were to prevent the diversion of such materials, personnel, and facilities from the manufacture of scarce items for the defense program.

As originally drawn the order specifically permitted (*a*) experimental and technological progress in this field, (*b*) the manufacture of color television for the Department of Defense and the Atomic Energy Commission, and (*c*) the manufacture of closed circuit color television for industrial or professional use.

Following further discussions with representatives of the television industry and on June 24, 1952, the order was substantially revised so as to remove all restrictions on the manufacture and assembly of color television products for other than home use. Manufacture and assembly for home use was allowed provided that permission was first obtained from NPA. The criteria for the granting of permission were set out in the order, a copy of which is herewith enclosed. No applicaiton was ever received for permission to manufacture or asssemble any of the products to which the order applies. The order has been reviewed at frequent intervals and its application discussed with representatives of the industry and with other interested parties.

In accordance with the policy of NPA to revoke controls that are no longer needed, the color television situation was again reexamined, the reexamination beginning about the middle of February. As a result of this review of the facts relating to the production of electronic equipment for the defense program it was determined that Order M-90 was no longer required and that it should be completely revoked. On March 13, 1953, a memorandum recommending such action was prepared in accordance with the established procedures of NPA and is now being circulated for comment by the interested agencies. The revocation is scheduled to come up for discussion at a meeting of the Order Clearance Committee of NPA to be held on Wednesday, March 25, 1953. Present indications are that no objection to this revocation will be made.

Respectfully yours,

H. B. McCoy, *Acting Administrator.*

Before proceeding with the introduction of the first witness I think it might be appropriate to announce the program of the committee, for the immediate future.

Today, Mr. E. W. Engstrom, vice president in charge of RCA Laboratories Division, David Sarnoff Research Center, Princeton, N. J., will be the first witness. Tomorrow, March 25, Mr. Frank Stanton, president, Columbia Broadcasting System, Inc., 485 Madison Avenue, New York 22, N. Y., will be the witness.

March 26, Mr. Richard Hodgson, president, Chromatic Television Laboratories, Inc., 1501 Broadway, New York 36, N. Y., will be the witness.

In that connection I might say that an invitation was extended to Dr. Lawrence to appear as a witness, but by telegram received this morning I am informed that he is out of the country at the present time, and his presence will be at a later date, for the committee.

On the same day, March 26, Dr. Allen B. Dumont, Allen B. Dumont Laboratories, Inc., 750 Brookfield Avenue, Clifton, N. J., will be a witness.

On March 27, Dr. W. R. C. Baker, chairman, National Television System Committee, vice president, Electronics Department, General Electric Co., Electronics Park, Syracuse, N. Y., will be the witness.

I also wish to announce that the tentative plans of the committee are for a demonstration to be held for the benefit of the committee on April 14 and 15, starting with the research laboratory at Princeton, on April 14, and continuing to New York for that afternoon and that evening and the following day for further demonstrations.

STATEMENT OF DR. ELMER W. ENGSTROM, VICE PRESIDENT IN CHARGE OF RCA LABORATORIES DIVISION, DAVID SARNOFF RESEARCH CENTER, PRINCETON, N. J.

The Chairman. This morning the committee in beginning its hearings has the very good fortune to have the presence of Dr. Elmer W. Engstrom, vice president in charge of the RCA Laboratories of the Radio Corporation of America.

While I regret that the State of New Jersey cannot claim Dr. Engstrom as a native citizen—he was born in Minneapolis—we are glad to have had him in our midst for the last two decades in the State of New Jersey. Certainly, Minnesota's loss has proven to be New Jersey's gain.

After leaving General Electric Company in 1930, Dr. Engstrom became associated with the Radio Corporation of America. In 1944, he was made a vice president of that company and was placed in

charge of the RCA Laboratories Division whose headquarters are at the David Sarnoff Research Center, Princeton, N. J.

Nothing that I can say can add to Dr. Engstrom's reputation as a fine research engineer. However, although Dr. Engstrom is here this morning to testify on the present status of color television, I do not want to fail to mention to the committee the citizens of the State of New Jersey are greatly indebted to Dr. Engstrom for the fine work that he has done in the field of television as chairman of the New Jersey Commission on Educational Television. The commission's first report was filed on March 3, 1953. It sets forth a program for educational television in New Jersey. The report urges the construction of a noncommercial educational television station at New Brunswick. It further urges that the Federal Communications Commission continue to reserve for a period of 2 years beyond June 2, 1953, the remaining 5 ultra high frequency channels now allocated to New Jersey for noncommercial educational television. I am confident that these recommendations, if carried out, will contribute greatly to the advancement of television as well as public education.

Dr. Engstrom is eminently qualified both as a research engineer and as a public-spirited citizen to present this morning his views on the present status of color television. Dr. Engstrom.

Dr. ENGSTROM. Mr. Chairman and gentlemen of the committee——

The CHAIRMAN. If you are willing, Doctor, so that we may know them, I would appreciate it if you present to the committee some of your associates who are here with you today.

Dr. ENGSTROM. Yes; I will be glad to. Mr. Robert L. Werner, who is vice president and general attorney, Radio Corporation.

Dr. C. B. Jolliffe, who is vice president and technical director, and Mr. Ray B. Houston, who is a member of Mr. Werner's staff.

Mr. John Carter, who is vice president in the manufacturing division of our company at Camden, N. J. And there are a number of others.

The CHAIRMAN. All of whom are important?

Dr. ENGSTROM. Yes, sir. Shall I proceed, Mr. Chairman.

The CHAIRMAN. Dr. Engstrom, you may proceed.

Dr. ENGSTROM. Mr. Chairman and members of the committee, my name and my position in the Radio Corporation has already been included in the chairman's introduction, so I shall not repeat that portion of my statement. At the outset I would like to express RCA's appreciation to this committee for inviting us to give testimony in the committee's investigation of the status of color television.

RCA also appreciates the fact that this committee has indicated its willingness to accept RCA's invitation to come to New York and Princeton in the near future and attend a demonstration of our color television system. For purposes of the record I have attached a copy of our letter of March 16, 1953, to Congressman Wolverton inviting this committee to visit and inspect our color television facilities in New York and Princeton.

Now, Mr. Chairman, I understand that I may proceed in 1 of 2 ways. One way, I might answer questions as I go through my statement, and the other is I might complete the statement and be subject to questions after that. I have a rather long statement.

The CHAIRMAN. Dr. Engstrom, it is the custom of this committee to have the witness complete his statement before there is any questioning of any kind.

Dr. ENGSTROM. Thank you.

The CHAIRMAN. We think it makes a better record to conduct the hearings in that manner.

Dr. ENGSTROM. Thank you.

I might also comment in your introduction you have covered material which I probably shall refer to also, but I shall do so, reflecting against the background of the story I am to present.

RCA'S POSITION ON COLOR TELEVISION

On October 10, 1950, the Federal Communications Commission adopted an order, in effect rejecting a compatable color television system—a system that would permit existing black and white sets to receive color pictures in black and white. In rejecting the compatible system, the Commission authorized a field-sequential system—a system to which all existing sets would be "blind" when tuned to a channel broadcasting color signals.

At that time, RCA took the position that this incompatible system would never be successful because, with it, there would be a minimum amount of color broadcasting available and there would never be a public demand for the type of color television sets which the proponents of the incompatible system had demonstrated before the FCC and that is exactly what has happened.

Although the people who sponsored the incompatible field-sequential system promised to broadcast at least 20 hours of color programs a week, actually they never broadcast more than a fraction of that. And none of those broadcasts was in the choice hours of 6 to 8 in the evening, in which some were promised. In addition, those broadcasts were confined almost exclusively to New York City.

Although the proponents of the field-sequential incompatible system indicated that their color television receivers, as well as the adapters needed so that black and white sets could receive the color broadcasts, were ready to be produced, they actually put only a few sets on the market.

Finally, less than 4 months after television broadcasting was authorized, the whole sorry chapter was brought to a close when the Office of Defense Mobilization issued a press release announcing that on that day it had officially requested the proponent of the incompatible color system to suspend its plans for the manufacture of color television receivers.

A month later, the NPA issued a formal order prohibiting the manufacture of color television sets requiring the use of critical materials.

But, as General Sarnoff pointed out at a meeting called in October 1951, by the NPA in Washington, the proponents of the incompatible system had failed to meet the commitments even before the order was issued. He also pointed out that even if the order were lifted he would expect that the proponents of the system would not go ahead with their previously promised program for the mass manufacture of color sets and broadcasting color programs.

We knew from our own experience that the authorization of an incompatible system would be a mistake. And we testified to that effect before the FCC. As a matter of fact, the best engineering minds in the industry had the same opinion and had so informed the FCC.

Our experience definitely convinced us that the only system which would succeed was a compatible all-electronic system.

We do not believe that the present FCC standards for incompatible color are satisfactory: First, the more than 22 millon black-and-white television receivers now in the hands of the American public, representing an investment by the public of billions of dollars, are "blind" to incompatible color broadcasts. Second, the present incompatible color standards are, in our opinion, unsatisfactory from a technical, engineering, and commercial standpoint for broadcast use.

For the reasons stated above, RCA has no present plans to manufacture field-sequential color television receivers designed to receive incompatible color signals under the Commission's present standards. The National Broadcasting Co. has no present plans to broadcast incompatible field-sequential color television programs. We have spent $20 million on laboratory work on color television, in addition to the many millions we had already spent on the development of black-and-white television. Last year, alone, we spent $5 million on color television experimental work, and these large expenditures are continuing this year. Information developed as a result of our research in color television has been made available to virtually the entire television industry. Today, we are convinced more than ever that we were correct in our earlier conclusion that the only system which would succeed is a compatible all-electronic system.

RCA has been, and is today, strongly in favor of color television. RCA has been, and is today, doing everything that it knows how to do to advance color television for the home. RCA has everything to gain by bringing color television to the American public at the earliest possible date.

RCA engineers are now working with the National Television System Committee (NTSC) to complete field tests of technical signal standards for compatible color television. Rulings of the Federal Communications Commission require that field tests be completed before any petition for new color television standards will be granted by the Commission.

Within 6 months at the latest, and possibly sooner, RCA expects to file a petition with the Federal Communications Commission for the adoption of compatible color television standards.

We have the know-how to broadcast color programs, we have the know-how to build the equipment to do the job, and we have the know-how to build the sets that will receive these color programs. In addition, we have a nucleus of trained personnel ready and waiting to do the job.

RCA is already manufacturing prototype compatible color receivers, tricolor tubes and studio equipment. When the Commission approves technical standards for compatible color television, RCA will manufacture and sell this apparatus to the public, to broadcasters and to other manufacturers.

At the same time, the National Broadcasting Co., Inc., an RCA subsidiary, will commence commercial broadcasts of compatible color television programs and will offer these programs to sponsors and to NBC affiliated stations throughout the United States.

In an answer for RCA to a recent letter of inquiry from Senator Charles W. Tobey, chairman of the Senate Committee on Interstate and Foreign Commerce, to the chairman of the National Television

System Committee, Dr. C. B. Jolliffe, vice president and technical director of Radio Corporation of America, has already furnished the Senate committee with an outline of RCA's plans and positions on color television. For purposes of completing the record I also attach hereto a copy of Dr. Jolliffe's letter of March 9, to Senator Tobey.

RCA COLOR RESEARCH AND DEVELOPMENT

To place this whole subject of color television in proper perspective, I shall briefly review some of the essential facts regarding the thought, time and effort that RCA has devoted to the creation of color television as a new service to the American public.

Research and development work in television have been continuously in progress in RCA for more than 25 years. Numerous RCA scientists and engineers who are presently engaged in television research and development, have worked on television problems during all or most of this time.

The RCA color television system is the culmination of these years of research and development. Step by step, in parallel with the development and improvement in black-and-white television, much thought and effort have been directed by RCA engineers to color television.

Early in 1940, a demonstration of electronic reproduction of color images was given by RCA at Camden, N. J., to members of the Federal Communications Commission.

In February 1941, color television signals were broadcast over the experimental television station of RCA's subsidiary, the National Broadcasting Co., Inc., from its antenna atop the Empire State Building. The system used at that time was a field-sequential system and the technical standards of operation of that system were essentially the same as the incompatible field-sequential system for which the FCC set standards—almost 10 years later—on October 10, 1950.

During our work in 1940 and 1941, we learned a great deal about the field-sequential system and its inherent limitations. Strong doubts were created in our minds concerning the eventual usefulness of this system to establish a practical color television broadcasting service. Further experiments and field tests were interrupted by the war, although RCA continued work throughout the war on military applications of television.

Immediately after V–J Day, RCA resumed work on both black-and-white and color television. While development work on television for entertainment had been interrupted by the war many advances in electronics and radio techniques during the war period had a direct influence on television.

Again, RCA made an investigation of the field-sequential color system and, in order to show the status of this type of color television, a public demonstration was given on December 13, 1945. In our opinion, the color pictures were good but the basic limitations of the field-sequential system remained. Technically, it appeared that the system could not give what we considered to be a satisfactory service and could not be integrated into the standards which had previously been adopted by the FCC for black-and-white television.

Late in 1945 and early in 1946, we came to the conclusion that a field-sequential system was neither a technically nor economically sound foundation upon which to build a color television broadcast service.

We decided, therefore, that RCA's efforts to bring color television to the public would better be concentrated on other approaches.

RCA DEVELOPS COMPATIBLE COLOR SYSTEM

Paralleling its work on field-sequential color, RCA had also been working on the development of an all-electronic simultaneous type of color television system by which all colors would be transmitted simultaneously instead of sequentially. This color system used a broader channel than the six megacycle channel which the FCC had specified in the technical standards which it had adopted for black and white television broadcasts. At that time, it was the general opinion of television engineers working in the color television field that, because of the band-width requirements for color, the ultra-high frequencies—commonly known as the UHF—would be the portion of the spectrum eventually used for color television broadcasts.

During 1946 and 1947 RCA demonstrated its all-electronic simultaneous color system. This work was the foundation of the RCA all-electronic color television system of today.

During 1947 and 1948, RCA also pursued an aggressive, continuous program of research and development designed to provide further information on possible use of the ultra-high frequencies. By that time it had become clear that the very high frequency (VHF) television channels allocated by the FCC to television broadcasters did not provide enough space for the full expansion of black and white television broadcasting service on a national basis.

Among the technical problems facing the television industry in 1948 were the lack of sufficient experience concerning UHF propagation; the magnitude of the necessary research and development to provide components and engineering information on which transmitters of required output power could be designed and built; the need for UHF frequency space for black and white channels and the desire to make color television possible on the VHF channels as well as the UHF channels. All of this brought us to realize the importance of learning to transmit color in a 6-megacycle channel, instead of the broader channel which was used by RCA in its demonstrations of all-electronic simultaneous color television in 1946 and 1947.

In our research program on the RCA simultaneous color system we had two principal objectives constantly in mind: (1) high standards of performance and (2) compatibility. By compatibility I mean the ability of black and white receivers to receive color broadcasts in black and white without any alteration to the receivers and the ability of color receivers to receive standard black and white broadcasts.

For these reasons, late in 1948 we came to the conclusion that if we were to have a technically and economically sound color television system soon, we would have to find a way to broadcast color in the standard 6-megacycle channel which had been prescribed by the FCC for black-and-white television. This concept of a 6-megacycle channel for color television was also that of the FCC in opening the hearings on color television in 1949.

Having provided a start in VHF we felt certain that transmitter tube advances and more knowledge of how to use UHF would permit expansion into the UHF for both color and black-and-white television. We held firm, however, on the two objectives we established for our-

selves in our research program on the simultaneous system early in 1946: high standards of performance—and compatibility.

FCC ADOPTS INCOMPATIBLE STANDARDS

The public hearings on color television which had been commenced by the FCC in 1949 were concluded in 1950. The RCA all-electronic compatible color television system and the incompatible field-sequential system were considered by the Commission during the course of these hearings.

With the incompatible field-sequential system all owners of present black-and-white sets would have to buy adapters and have the adapters installed on their sets in order to be able to receive the color broadcasts in black and white. These devices would have to be purchased and added to the black-and-white sets the public had previously bought and paid for. If they also wanted to get broadcasts in color they would have to buy additional apparatus.

We pointed out that this defect of incompatibility of the field-sequential system, the absence of an audience, as well as the other inherent limitations of that system, made its success as a broadcasting service to the public very dobutful.

We pointed to the fact that the RCA system of color television was a modern all-electronic system which did not require adapters or anything else to enable the millions of sets already in the hands of the public to receive color programs in black and white and thus provided an existing and growing audience.

We stressed the fact that the RCA compatible color television system would be made ready for commercial production if the Commission would set standards for it promptly.

The advocates of the field-sequential system claimed that they were all ready to begin operations and that if the Commission set standards on their system the public would have color television promptly after FCC authorization.

The FCC rejected the RCA all-electronic compatible system and, on June 25, 1951, gave the go-ahead signal to commercial color television broadcasting on the basis of standards for the incompatible field-sequential system.

Promoters of the field-sequential system committed themselves before the Commission to broadcast, within 3 months after FCC approval, a schedule of at least 20 hours a week of incompatible color broadcasts, part of which would be in the choice broadcasting hours between 6 and 8 in the evening.

After FCC approval of the incompatible system, what little color they did broadcast was confined almost entirely to New York City and was not within the choice broadcasting hours. And they put only a few color sets on the market.

Those who advocated the field-sequential system failed to broadcast their color programs as they had said they would and failed to manufacture color receivers in quantity as they had said they would.

This was to be expected of an incompatible system. It proved the truth of what RCA had told the Federal Communications Commission would happen were it to adopt exclusive standards for the incompatible field-sequential system.

In this connection, it is interesting to note an article which appeared in the New York Times of March 15, 1953. Mr. Jack Gould, radio editor of the New York Times, commenting on why color television is not in general use today, said:

> The basic reason for the lack of color television now lies in the practical shortcomings of the Columbia Broadcasting System's method of transmitting color video, which is the system adopted by the Federal Communications Commission. Nominally, the CBS standards are operative as of the moment.
>
> The fatal drawback to the CBS system is that it is virtually impossible to introduce because it is incompatible with present TV. When CBS puts on a color program, the owner of a black-and-white set sees just a lot of jibbly lines. To make a picture in black and white, the set owner must buy an adapter. Not many people will want to spend money just to obtain in a different way what they have now.
>
> The problem is even more elemental on the programing end. Who is going to spend the money to put on a color show, if it means the loss of virtually all of the existing audience?
>
> As both an economic and technical necessity, it long has been abundantly clear that an alternative system of color transmission would take the place of the CBS method.

EFFECT OF NPA ORDER M–90

On October 19, 1951, just short of 4 months after incompatible color broadcasts had been authorized by the FCC, the Office of Defense Mobilization issued a press release announcing that on that day it had officially requested the proponents of the incompatible color system to suspend their plans for the manufacture of color television receivers.

This was the first notice or knowledge RCA had that any such plan was even being contemplated by the Government. Within minutes after the official Government announcement, the proponents of the incompatible system issued a press release saying that it would "comply immediately with ODM's request."

Their press release went even further than the Government request. It announced that they not only would stop manufacturing incompatible color receivers, but they also would stop broadcasting incompatible color programs.

On October 25, 1951, in response to a request by the Office of Defense Mobilization, a conference to discuss the subject took place in Washington with representatives of the television set manufacturing industry. Brig. Gen. David Sarnoff, chairman of the board of Radio Corporation of America, was there. Representatives of other television manufacturers were also there.

At this meeting General Sarnoff said that RCA would comply with any program which the national defense required. Other manufacturers present said the same for their companies.

The sense of the October 25 meeting was that no formal implementing order was necessary. However, on November 20, the NPA pointed out that legal complications might arise as a result of the informal Government-industry agreement and accordingly the NPA issued its formal Order M–90.

At a second meeting on February 8, 1952, held by the National Production Authority in Washington, the industry was invited to review the situation and consider whether there should be any change in NPA Order M–90.

General Sarnoff represented RCA at this meeting also. He pointed out that the proponents of the incompatible system failed to meet their commitments even before NPA Order M–90 was issued and that even if NPA Order M–90 were to be lifted, he would expect that the proponents of the incompatible system would not go ahead with their previously promised program for the mass manufacture of color sets and broadcasting color programs.

When NPA Order M–90 was instituted, we stated that we would cooperate fully with the defense program, but that if the NPA should decide that Order M–90 should be rescinded we would offer no objections to rescinding it.

Although it appears that NPA Order M–90 may be rescinded soon, we do not believe that rescinding of the order will be followed by substantial broadcasting of incompatible color programs or by mass production of incompatible color receivers.

NBC COLOR TEST BROADCASTS

From September 1949 to April 1950, using the facilities of NBC Station WNBW at the Wardman Park Hotel, RCA broadcast nearly 900 hours of compatible color television tests and demonstrations over channel 4 in Washington. During the same period, over experimental UHF Station KG2XCL, which also used NBC's Washington facilities, RCA broadcast almost 600 hours of compatible color television tests on a UHF channel. We continued our operation in Washington until January 1951 and during that period continued to broadcast a substantial number of color test programs.

In 1951 RCA moved the center of its experimental color operations from Washington to New York. This move was made to facilitate expansion of NBC's color work and to permit added participation by the various groups at NBC headquarters responsible for commercial television broadcasting.

Completely new color equipment was designed and installed in one of NBC's Radio City studios. The equipment, which was designed by the RCA Victor division at Camden, N. J., embodied improvements developed as a result of the Washington experience and included the latest developments by RCA and NBC engineers.

In order to expedite color television broadcasting development a special group was established in NBC. Members of this group, recruited from the regular NBC staff on the basis of their qualifications, have devoted their efforts to the development of color television broadcasting.

The expanded activity included participation by the various departments and groups of NBC concerned with program planning, production, staging, scenery, customing and makeup, as well as technical operating and engineering personnel. Broadcasting of color pictures from programs originating in the newly equipped studio began in the spring of 1951 and have continued to date.

Since its activation, this color studio has been used exclusively for experimental color programs and hundreds of hours of these programs have been broadcast on the air over NBC's New York experimental station KE2XJV.

An important phase of this NBC activity has been the training of a substantial number of people to prepare for eventual itnegration of

commercial color broadcasting into the existing television broadcast service. In addition, to the NBC personnel permanently assigned to color work, other NBC personnel have been assigned to color on a limited basis in order that the personnel with experience in this field would be increased.

NBC's work provided practical solutions to the new problems which the broadcaster faces in color. The NBC experience is also valuable as an aid in formulating plans to produce commercial programs on a regular basis to meet the needs of a future comercial program service in color.

RCA AND NBC WORK ON NTSC STANDARDS

Following the FCC color television hearing in 1950, RCA continued its research and development work on its all-electronic compatible color television system. We also cooperated with the National Television System Committee (NTSCO) and furnished information obtained in our research to members of that committee and to manufacturers so that research and development work on color television could progress most rapidly throughout the television industry.

The National Television System Committee is an organization of scientists and engineers. This group has been working for the past 2 years on the development of improved standards for color television for submission to the Federal Communications Commission.

Dr. W. R. G. Baker is chairman of the NTSC and I am one of the vice chairmen.

Laboratory work, field tests and close cooperation with the technical panels of NTSC by RCA, NBC, and others resulted in a set of proposed signal specifications for field testing which were released by NTSC on November 26, 1951, RCA and NBC immediately began field testing these specifications and the equipment necessary to broadcast and receive color signals. Other companies also used these specifications for field testing.

During 1952 RCA and NBC carried on three parallel lines of investigation: extensive field testing of color receivers, exhaustive tests devoted to compatibility to assure ourselves that the many types of black and white receivers in use would perform satisfactorily on the new signal, and research centered on the problem of making the results of the signal specifications fit the physiological characteristics of the human eye.

In order to assure ourselves that the various types and makes of black and white receivers in the hands of the public would perform satisfactorily on a compatible color television signal, RCA and NBC devoted a substantial amount of time during this period to compatibility tests.

These compatibility tests have been conducted in two ways: First, by gathering a number of representative black and white receivers for viewing by skilled observers and, second, by soliciting response from members of the public as to the quality of the reception of NBC color broadcasts on the black and white sets in their homes. The response to the tests confirmed the judgment of our engineers.

Information obtained from investigations carried on by the RCA laboratories on the problem of making the results of signal specifications fit even more closely to the physiological characteristics of the human eye was applied to the circuit developments in both the studio

and the receiver and enabled us to provide improved color circuits and pictures.

The work done by RCA, NBC, and others during 1952 helped to formulate improved signal specifications for the NTSC. The new specifications were approved by the NTSC for publication on February 2, 1953. These signal specifications are, in basic respects, similar to the standards which RCA proposed to the Federal Communications Commission at the 1949–50 hearings, but naturally reflect improvements resulting from the knowledge gained during the research and field tests conducted by ourselves and others since those hearings.

Now, Mr. Chairman, not with the thought of becoming technical in my presentation, but I would like to restate what I have said in the following paragraph. While we were before the Federal Communications Commission in the hearings in 1949 and 1950, we proposed a system, the signal for which had all of the characteristics which are in the black and white signal which is being currently transmitted by television stations. This is the aspect of the signal that makes it compatible. It is a characteristic that provides that a black and white receiver will receive that program in the normal way and reproduce the picture in black and white.

A second characteristic of the signal is added to the black and white characteristic, that up near the top of the band that is used for the transmission of the black and white information we had a second radio carrier, and by suitably inoculating the second radio carrier we could include the information which would tell the receiver what to do about the color of the various parts of the picture.

We had a third characteristic of the signal; that is the synchronizing which sent this color information into the receiver.

There is additional information added to the black and white synchronization.

Now, finally we have those three things today in the signal specifications which are agreed upon by the NTSC for field testing. Then, there is a difference between that time and now, because of improvements, because naturally we have learned things in the meantime. We have worked out better ways of doing it. But, fundamentally it is the same kind of a structure for the signal and the system, of course, would vary in terms of the apparatus' characteristic; but I point that out because there is, and has been an ample period of experimentation which began in 1949 and which has been continuous in terms of making improvements since that time. So, we have a background of experience.

Since early in February 1953, the National Broadcasting Co. has been transmitting test signals based on these specifications during the time which the FCC has made available for test television broadcasts.

NBC has now completed equipping a second television studio for compatible color television. This studio occupies the whole of the Colonial Theater at 62d Street and Broadway in New York City. The Colonial Theater is equipped with all new color studio equipment built by the RCA Victor Division at Camden, N. J. This equipment was designed on the basis of NBC experience and of research carried on by RCA engineers at Princeton and Camden. The first color broadcast from the Colonial Theater was made this past Thursday, March 19.

RCA and NBC are continuing to work in close cooperation with the NTSC in field tests of the improved signal specifications. Since, as I have outlined, we have already conducted extensive laboratory investigations and signal testing, we are confident of a favorable outcome from the field tests.

Thus far, I have discussed the work of RCA and its broadcasting subsidiary, NBC, towards achieving a suitable set of technical standards for compatible color television. The standards employed for color broadcasting bear a direct relation to the apparatus which can be used for broadcasting and receiving the color signals.

The spectacular success and growth of black and white television is due in large part of the fact that the FCC black and white standards which were set in 1941 were based upon a system of all-electronic television. RCA believes that in setting standards for color television the same considerations should apply.

RCA believes that it is of major importance that any set of specifications adopted as standards make provision for future improvements in color equipment—both at the broadcasting and the receiving end. The NTSC color-television standards now being used by RCA and NBC for field tests make this provision for future improvements. By setting such sufficiently high standards, and not limiting these standards to the capabilities of present-day equipment, the fruits of research and invention in the coming years can result in better equipment in both transmitter and receiver, giving better performance and better pictures without requiring a change in standards and without obsoleting color or black and white sets purchased by the public.

THE RCA TRICOLOR TUBE

The RCA tricolor picture tube, a product of research by RCA, was the first tricolor picture tube ever successfully demonstrated.

The heart of our color television receiver is the RCA tricolor tube. The RCA tricolor tube can also be used with any other type of color television receiving set.

Work on tricolor tubes was at first directed at basic principles. A large number of types were tested and a tube of one type was built as early as 1945. Based upon the results of our research work, a decision was reached in 1949 to concentrate on the shadow-mask tube since it fulfilled the basic technical requirements as well as those of early mass production.

The practicality of the basic principles of the design of this tube was demonstrated by us at the first public demonstration of our tricolor tube in March of 1950.

Following this satisfactory demonstration of basic principles we have continued research and development on improved tricolor tube models.

We also invested substantial sums in a pilot operation so as to work out tricolor tube production techniques and to produce a substantial number of the tubes. As a result, we have already developed a nucleus of trained operators, supervisors, and engineers for a mass-production unit.

In August 1950 RCA commenced work on the pilot plant setup in the tube factory of the RCA Victor division at Lancaster, Pa. We chose that location so that the pilot operation might have the benefit

of association with the engineering activities on black and white television kinescopes already centralized at the RCA Lancaster plant.

In this pilot operation we have produced tricolor kinescopes, we have made runs to try a number of design features and runs to try production processes and procedures. Sometimes a cycle has ended with the completion and test of a tricolor tube. At other times the cycle had ended with a subassembly of the tube. In all, we have started approximately 7,000 tricolor tubes in this pilot-plant operation.

A part of our program is to complete a small number of tubes each day for engineering tests. This supplies a reservoir of tubes which we keep for apparatus and field tests. Other completed tubes, not needed for these purposes are, after test, opened so as to reuse some of the parts for the next production cycle. In this way we conserve materials and assemblies.

The RCA pilot tricolor tube plant occupies approximately 7,500 square feet of floorspace. In addition, the regular factory facilities supply the pilot operation with materials, machined parts, and processing equipment. We have employed as many as 80 people in this pilot-plant operation and the number employed in the operation has varied from this figure to a lesser number depending on the character of the operation under way.

In order that the television set and tube manufacturing industry could participate and contribute to the maximum extent to the development, testing, and introduction of color televsion, RCA presented a symposium for competing manufacturers on June 19 and 20, 1951, in New York.

At this symposium detailed technical and engineering information on the tricolor tube and its operation was presented to the industry. Also at this symposium each manufacturer was advised that if he sent a letter stating that he was engaged in color television development work or field testing he would be sent an RCA tricolor tube and associated circuit components without charge. In addition, tube manufacturers engaged in color television development work were advised that they would be sent without charge a complete set of parts for the color tube.

As part of this program, 152 companies were given tricolor tubes and associated components with the entire cost being borne by RCA. Subsequently, additional tricolor tubes and components were sold to these and other companies interested in color television. To date 477 tubes have been supplied under this program to different companies.

A step beyond the RCA tricolor tube pilot plant operation, and growing out of it, have been plans for a manufacturing unit. Late in 1951 we laid plans for such a unit and began the design of factory machinery which would enable high-speed commercial production of tricolor tubes. The plans provided that the manufacturing facilities be arranged to incorporate sufficient flexibility to enable the production of different types and sizes of tricolor tubes.

This manufacturing unit, which will have a production capacity of 2,000 tricolor tubes per month, can serve as the prototype for other units in the establishment of factory facilities for large-scale, high-speed production. As demand for tricolor tubes increases, additional units will be installed for increased production. The prototype unit will be available this year and, together with a nucleus of personnel

already trained in our pilot plant operation, can serve as the basis for quantity production.

THE RCA ALL-ELECTRONIC COLOR RECEIVER

During March 1950, we demonstrated the first color receiver for the RCA color system using the RCA tricolor tube. In October 1949, our color receiver models had used 3 separate picture tubes, 1 for red, 1 for blue, and 1 for green. Since the introduction of our early color receiver models, we have constantly refined and improved color receiver design.

Our current color television receiver models contain 34 tubes in addition to 1 tricolor tube. This is less than one-half the number of tubes required by our early laboratory model color television receivers. For purposes of comparison I may state that modern black and white receivers usually contain from 18 to 24 tubes in addition to 1 black and white picture tube.

This reduction in the number of tubes in our color receivers was achieved as the result of an intensive program to simplify and reduce circuits of the earlier experimental color receiver models. This program is still going on, and we expect that, as we obtain more experience in building color receivers and tool up for commercial mass production. there will be further simplification and reduction of circuitry and tubes.

When the FCC approves standards for a compatible color television system, we will immediately put into effect plans to mass-produce color television receivers and tricolor tubes. We would gear our production of color television receivers to public demand and, to the extent necessary to meet that demand, draw upon our existing black-and-white receiver production facilities for the manufacture of color television receivers.

RCA COLOR BROADCAST EQUIPMENT

I have already outlined the extensive work done by the National Broadcasting Co. in their test and development program on studio and transmitting equipment for compatible color television. A black and white television broadcast transmitter of the type now in use for either VHF or UHF television broadcasting can transmit compatible color television signals. For that reason any network station can broadcast color television programs which are relayed to it.

Networking of television programs is necessary not only for black-and-white television but also for any color television system. Two types of networking facilities are now available. The present wide-band microwave circuits will carry compatible color television broadcasts with no additional equipment. The coaxial cable circuits now provided by the Bell System require the addition of some simple network terminal equipment which RCA has already developed. With the addition of this equipment compatible color broadcasts can be networked over the coaxial cable. This method was first demonstrated by RCA to the FCC in 1950. Research effort has continued to improve the method and the equipment and since that time many additional tests have been successfully made.

In October 1951, a test program of the RCA compatible system was transmitted across the Nation to San Francisco and Los Angeles and

relayed back to New York where it was received on an RCA color receiver. In all, these compatible color signals traveled a distance of nearly 8,000 miles.

NEW RCA TRICOLOR CAMERA TUBE ANNOUNCED

As in black-and-white television, we believe that the color cameras for both studio and for service outside of the studio should be all-electronic. In the work done to date with compatible color television, RCA has used all-electronic cameras. These comeras have each utilized 3 pickup tubes, 1 for each of the 3 primary colors. These cameras have worked well and are a part of the studio equipment NBC is now using for field tests. In addition to studio use, these cameras have also been used for remote pickup work as part of an NBC mobile color television camera unit used for test broadcasts of outdoor scenes.

There are, however, important reasons for using a single tricolor camera tube in the color camera as well as a tricolor receiving tube in the color receiver. Development of a single tricolor tube for the camera has been the subject of intensive research in RCA.

I can announce today that RCA has completed the basic work on a tricolor electron tube for use in a color television camera. This will make it possible at a future time to eliminate the present three-tube camera for compatible color television and to substitute a simple and efficient single-tube color television camera. This will not require any change whatever in the standards that will be recommended to the FCC for a compatible system of color television.

The new tricolor camera tube has been tested in a color television camera and it performs the necessary functions. We are now conducting further tests of the new tricolor camera tube to serve as a guide for continuing development and improvement.

RCA WILL LICENSE ANYONE TO USE ITS INVENTIONS

On March 13, 1953, at a hearing of this committee, the question was asked whether there was a willingness to license patents which might be used in color television.

I should like to state that for many years the policy of Radio Corporation of America has been to license its patents without restriction to anyone who desires a license. This policy has been confirmed by the entry of our patents upon the Register of Patents Available for Licensing of the United States Patent Office. This entry appears at page 366 of the Official Gazette of the Patent Office of December 18, 1945.

Thus, anyone can obtain a license for any appartus in which RCA patents may be used. Our licensees are free from any restrictions as to selling prices, production quotas, territorial limitations, or any other limitations. Our licenses are granted on standard nondiscriminatory terms to any applicants, require no minimum royalty payment and our royalty rate is small, amounting to only 1¾ percent of the manufacturers' wholesale selling price.

Anyone who is already licensed by RCA for black-and-white television appartus is also already licensed to use any patents under which RCA can grant a license for color television appartus. There is no additional royalty charge for this added right.

PRESENT FIELD TESTING ACTIVITIES

I have previously referred to the extensive studio and test facilities maintained by NBC in the New York City area. In addition, RCA has facilities supplementing those provided by NBC. Our color equipment has been adjusted to the tentative signal standards approved by NTSC on February 2, 1953. We are now engaged in field testing their equipment using these NTSC standards. This field testing is being carried on for the purpose of our own observation and also as a part of the NTSC program for field testing.

The Federal Communications Commission, in its public notice 65008 of June 11, 1951, established certain criteria to be met by the proponent of any new color television system. During the field tests now taking place we expect to accumulate the data which the FCC requires as a condition before it will approve standards for a new color television system. When the field tests are completed this information will be presented to the FCC for the purpose of requesting a hearing to obtain approval to broadcast compatible color television.

RCA WILL PETITION FCC FOR COMPATIBLE COLOR STANDARDS

RCA expects that it will file a petition with the FCC for the approval of standards for compatible color television within 6 months, or possibly sooner. As soon as the FCC hearings are completed, and if the Commission sets standards for compatible color television, RCA will immediately commence production of color television receivers, tricolor tubes and studio equipment. The National Broadcasting Co. will commence broadcasting compatible color television programs and will offer these programs to commercial sponsors and NBC affiliated stations throughout the United States.

However, in the interests of bringing color television to the American public at the earliest possible date, we believe that the Commission can proceed without the time and expense of formal hearings in this matter. The Commission and its staff have been kept advised of the extensive research and development work which has been done on compatible color television by RCA and other members of the NTSC.

I have been advised by the general attorney of RCA that, in his opinion, there is no statute of the Congress nor other law which prohibits the Commission from acting immediately, on its own motion and without a hearing, to permit the commercial broadcasting of compatible color signals by all television broadcasting stations tomorrow. There is being submitted together with this statement a memorandum of law prepared by the RCA General Attorney which shows why our recommended procedure is in accord with the law.

To accomplish this we make the following specific recommendation:

That the Federal Communications Commission immediately authorize commercial broadcasts of compatible color television signals in addition to the broadcasting of incompatible color television signals it has previously authorized.

The broadcasting of compatible color television will not interfere in any way with the present service being rendered to black-and-white television set owners. Nor will there be any interference with

the broadcasting of incompatible color television should any television station wish to broadcast incompatible color signals.

We are today prepared to commence broadcasting compatible color programs which can be received in black and white on sets now in the hands of the public without changing these sets at all and without any present set owner being required to buy any new equipment to receive these broadcasts.

We are also prepared to expedite the production of color sets so that those members of the public who want to receive our compatible color broadcasts in color can buy color receivers.

Given this opportunity to judge for itself the advantages or disadvantages of the compatible and incompatible system of color television, the American public would make the final decision as to which system it prefers. In our opinion, this is the quickest way to bring color teleivsion service to the American public.

That, Mr. Chairman, completes my statement.

The CHAIRMAN. Dr. Engstrom, we greatly appreciate the full and complete, as well as interesting statement, that you have made to the committee this morning in apprising us of the development that has taken place in recent years with reference to color television, particularly do we appreciate the optimism that permeates your whole statement as to the possibility that in the very near future, if and when action is taken by the Federal Communications Commission, that the result of your studies and your development could be and will be available to the people of this Nation.

As a part of your statement you have made reference to certain correspondence and also to a memorandum of law that has been prepared by Robert L. Werner, vice president and general attorney, Radio Corporation of America, having as of counsel Eugene E. Beyer, Jr., Ray B. Houston, and John H. Bermingham, dealing with the power of the Federal Communications Commission to authorize immediate broadcasting of compatible color television.

This correspondence and this memorandum of the law and appropriate documents will be made a part of the record following your statement.

(The letters above referred to are as follows:)

RADIO CORPORATION OF AMERICA,
RCA VICTOR DIVISION.
Camden 2, N. J., March 16, 1953.

Hon. CHARLES A. WOLVERTON,
Chairman, Interstate and Foreign Commerce Committee,
House of Representatives,
Washington, D. C.

MY DEAR CONGRESSMAN WOLVERTON: Your telegram of March 14 was received in Mr. Folsom's absence on a business trip to the Pacific coast and in order to avoid delay I am glad to reply for Radio Corporation of America.

RCA will be prepared to testify in the hearings on the present status of color television on March 24, or on whatever other day the committee may fix. It is our present intention to have the RCA testimony presented by Dr. Elmer W. Engstrom, vice president in charge of the RCA laboratories division. Dr. Engstrom is responsible for RCA color-television research and is also a vice chairman of the National Television System Committee (NTSC). He is thoroughly familiar with our work in color television as well as the work of the NTSC.

We believe that it would be extremely helpful to the committee in its investigation of the present status of color television were the members of the committee to visit New York and Princeton on the Monday prior to the commencement of the hearings.

In New York we would be prepared to demonstrate to members of the committee the first television studio specifically designed for color-television programs, together with the apparatus involved in the production and broadcast of a color-television program. The equipment in this studio, which is located at the Colonial Theater, could be compared by members of the committee with the regular NBC black-and-white television equipment. By demonstrating operations of the color studio and equipment to the committee we believe that we could furnish members of the committee more factual information on the present status of color television than is available anywhere else.

In addition, we believe that it would be fruitful for the members of the committee to visit the David Sarnoff Research Center at Princeton, N. J., where we would outline our plans for future development work in the color-television art and demonstrate laboratory developments. With the factual data available in New York and Princeton, we believe the committee would be better prepared to evaluate the testimony which will be produced by the various witnesses at the committee hearings.

Naturally, we would be pleased to make all arrangements for the trip and for transportation of the committee and staff to New York and Princeton and return.

We appreciate the opportunity of offering testimony at the committee hearings and upon advice from you we would like to proceed with arrangements for a visit by the members and staff of the committee to New York and Princeton on March 23.

Respectfully,

JOHN S. CARTER.

RCA CORPORATION OF AMERICA,
New York 20, N. Y., March 9, 1953.

Hon. CHARLES W. TOBEY,
Chairman, Committee on Interstate and Foreign Commerce,
United States Senate, Washington, D. C.

MY DEAR SENATOR TOBEY: In accordance with Dr. W. R. G. Baker's letter of March 6 to you that he has forwarded copies of your letter of February 20 to companies engaged in work with the NTSC, we are glad to furnish the following information about RCA's plans in response to the questions in your letter:

"(*a*) Does any member of your group plan to manufacture any receiver sets capable of receiving the color signals under the Commission's present standards? If not, why not?"

RCA has no present plans to manufacture field sequential color television receivers designed to receive incompatible color signals under the Commission's present standards.

We do not believe that the present FCC standards for incompatible color are satisfactory. First, the more than 22 million television receivers now in the hands of the American public, representing an investment by the public of billions of dollars, are "blind" to incompatible color broadcasts. Second, the present incompatible color standards are, in our opinion, unsatisfactory from a technical, engineering and commercial standpoint for broadcast use.

"(*b*) Does any member of your group propose to manufacture receivers capable of receiving color signals under any other standards. For example, under the signals specifically approved by NTSC. If so, when do they expect to start production? If not, why not?"

RCA will manufacture color receivers capable of receiving compatible color signals under the NTSC standards when the Federal Communications Commission approves commercial color broadcasts under these standards. RCA is already manufacturing prototype model receivers, tricolor tubes, and studio equipment for these standards and plans mass production after FCC approval.

"(*c*) Do you know if anyone is going to request the Commission to adopt new standards for color broadcasts? If so, when and who?"

RCA expects to petition the Commission for the adoption of NTSC compatible color television standards within 6 months.

RCA engineers are now working with NTSC to complete field tests required by the FCC before the Commission is petitioned to adopt new standards.

In his letter to you Dr. Baker wrote:

"A primary objection of this Committee was to attempt to create a practical color transmission which would utilize as a foundation, the existing monochrome transmission standards. All interests involved in this issue, includ-

ing the FCC as well as other system proponents, have unanimously agreed on the desirability of this objective. They have only disagreed on whether, and when, it is possible of attainment.

"If it is possible to base color on the current monochrome standards, then this important improvement in this service can be realized without reducing the value of a single one of the millions of television receivers owned by the American public."

We believe that this has been achieved.

If there is any further information which you desire we would appreciate your advising us.

Sincerely,

C. B. JOLLIFFE.

(The memorandum of law above referred to is as follows:)

MEMORANDUM OF LAW ON THE POWER OF THE FEDERAL COMMUNICATIONS COMMISSION TO AUTHORIZE IMMEDIATE BROADCASTING OF COMPATIBLE COLOR TELEVISION

QUESTION PRESENTED

Is there any statute of the Congress or other law which would prohibit the Commission from acting immediately, on its own motion and without a hearing, to permit the commercial broadcasting of compatible color signals by all television broadcasting stations?

FACTS

In 1941 the Federal Communications Commission first adopted technical signal standards for the broadcasting of black-and-white television signals. These standards defined the type of electrical signal which the broadcaster sends through the air to be received by members of the public on television sets in their homes.

The composition of the electrical signals which are broadcast determines the type of picture which is picked up by a television receiver. The black-and-white technical signal standards adopted by the Commission are included in the FCC Standards of Good Engineering Practice.

These standards insure that all television receivers tuned to the proper channel and within broadcasting range will receive the programs which are broadcast.

On October 10, 1950, the FCC adopted technical signal standards for the broadcasting of field sequential color television signals. These standards, which are also included in the FCC Standards of Good Engineering Practice, authorize broadcasting of a type of electrical signal that can only produce pictures on television receivers equipped to receive field-sequential signals.

None of the more than 22 million black-and-white television receivers now in the hands of the public can receive field-sequential color signals, even in black-and-white, without the owner spending money on additional apparatus.

The RCA color television system is a compatible color television system. It operates on tentative signal specifications set by the National Television System Committee (NTSC), a group of engineers.

The characteristics of the NTSC signal specifications are such that the signal can be received in black-and-white on ordinary black-and-white television receivers without any adjustments or extra apparatus. This important feature, known as compatibility, is possible because the NTSC color television signal specifications include, in general, the black-and-white standards previously authorized by the FCC and now in use.

These compatible color signals will also actuate the circuits of compatible color television receivers so that they may receive the signal in color.

Despite the fact that compatible color television signals provide an excellent black-and-white picture on all black-and-white receivers now in the hands of the public and generally include existing black-and-white signal standards, the FCC does not permit any television broadcasting station to broadcast compatible color television signals on a commercial basis.

The FCC has determined that it will not grant any petition to approve standards for compatible color television unless certain time-consuming procedures are followed and the signals have been thoroughly field tested.

The FCC has, on three previous occasions, first in 1941 and again in 1947 and 1950, refused to authorize various types of color television standards.[1] In each of these cases the FCC gave as one of its reasons for turning down a color system presented, the fact that the color system had not been adequately field tested.

In the words of the FCC "before approving a new system of television it is indispensable that there be an adequate program of field testing." [2]

To avoid the possibility that the NTSC compatible color signal specifications might be rejected as standards by the FCC, exhaustive field tests of NTSC compatible color television signals are now in progress. It is expected that these field tests will be completed within the next few months.

Point I

THE CONGRESS HAS PASSED NO LAW WHICH PROHIBITS THE IMMEDIATE AUTHORIZATION OF COMPATIBLE COLOR TELEVISION BROADCASTS

The Communications Act of 1934, as amended, gives the FCC general authority to regulate television transmission and to provide standards for television broadcasting.

No provision in the Communications Act prohibits the Commission from acting on its motion to permit immediate broadcasting of compatible color television signals.[3] Although the Commission has promulgated certain regulations under the Communications Act, there is nothing in the act which prohibits the Commission from waiving, suspending, interpreting or modifying these regulations in its discretion.

The courts have consistently recognized that the Commission must be allowed great flexibility in its procedure. This great flexibility is required in order adequately and effectively to regulate and encourage the rapidly developing broadcasting art.[4]

As the Supreme Court has stated:

"Underlying the whole (communications) law is recognition of the rapidly fluctuating factors characteristic of the evolution of broadcasting and of the corresponding requirement that the administrative process possess sufficient flexibility to adjust itself to these factors." [5]

In 1949 the Supreme Court again expressed its view of the necessity for flexibility in Commission procedures. Referring to section 4 (j) of the Communications Act, which empowers the Commission to "conduct its proceedings in such manner as will best conduce to the proper dispatch of business and to the ends of justice," the Court stated:

"In this wording Congress was mindful not only of the ends of justice but also of the proper dispatch of the Commission's business, a matter not unrelated to achieving the ends of justice, and left largely to its judgment the determination of the manner of conducting its business which would most fairly and reasonably accommodate those ends." [6]

Apart from the broad authority vested in the Commission by the Communications Act, the Commission's authority to formulate, interpret or modify its rules is affected by the Administrative Procedure Act. This act prescribes procedures for rule making by Federal administrative agencies.

Section 4 of the Administrative Procedure Act requires that notice and opportunity to comment must be given for certain rule making proceedings but these requirements do not

". . . apply to interpretative rules, general statements of policy, rules of agency

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[1] Report of the Commission, May 3, 1941, Docket No. 5806; Report of the Commission, March 18, 1947, Docket No. 7896; Second Report of the Commission, October 10, 1950, Docket Nos. 8736 et al.

[2] Report of the Commission, p. 4, March 18, 1947, Docket No. 7896.

[3] There are certain instances in which the Communications Act requires public hearing prior to the promulgation of rules or orders by the Commission. For example, sec. 303 (f) provides that changes in frequencies, authorized power, or times of operation of any station shall not be made without the consent of the station licensee, unless there is a public hearing. However, none of these provisions for hearing is applicable to the instant case.

[4] Sec. 303 (g) of the Communications Act of 1934, as amended, directs the Commission to:

"Study new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest."

[5] *Federal Communications Commission* v. *Pottsville Broadcasting Co.* (309 U. S. 134, 138 (1940)).

[6] *Federal Communications Commission* v. *WJR, The Goodwill Station, Inc., et al.* (337 U. S. 265, 282 (1949)).

organization, procedure, or practice, or in any situation in which the agency for good cause finds (and incorporates the finding and a brief statement of the reasons therefor in the rules issued) that notice and public procedure thereon are impracticable, unnecessary, or contrary to the public interest."

Moreover, even where notice is required, section 4 (b) of the act provides that after notice the agency is not required to hold a hearing but need only afford interested persons an opportunity to participate through submission of written data, views or arguments.

The Commission itself has recognized that its rules are not inflexible or sacrosanct. In fact the Commission's General Rules of Practice and Procedure specifically provide as follows:

"§ 1.701 Suspension, amendment or waiver of rules.—The rules and regulations of the Commission may be suspended, revoked, modified, amended, or supplemented, in whole or in part, at any time by the Commission, subject to the provisions of the Administrative Procedure Act. Any provision of the rules may be waived by the Commission, if good cause therefor exists."

In a recent case in which the Commission aproved an application despite the recognition that there was a "significant departure" from its Standards of Good Engineering Practice, the Commission stated:

"We further believe that rigid adherence to the standards in cases such as this would preclude the assignment of facilities in a manner best serving the public interest, for this Commission has consistently held that a primary objective of §§ 1 and 307 (b) of the Communications Act is to provide at least one primary radio service to all substantial populations of this country. Past cases by the Commission make clear that the Standards of Good Engineering Practice were established as a guide to assist the Commission in the allocation of broadcast stations, and have been liberally interpreted, in cases such as this, in order to effect the most widespread and effective broadcast system possible."[7]

This same broad and flexible approach can also be applied by the Commission to the technical standards for black-and-white television broadcasting in order to "effect the most widespread and effective broadcast system possible."

POINT II

THERE ARE PROCEDURES AVAILABLE BY WHICH THE COMMISSION MAY IMMEDIATELY ON ITS OWN MOTION AND WITHOUT HEARING, AUTHORIZE COMMERCIAL BROADCASTING OF COMPATIBLE COLOR TELEVISION SIGNALS

The Commission may, on its own motion and without hearing, (1) interpret its existing rules to permit the broadcast of compatible color television signals, and (2) modify any of its existing rules which in its opinion would prohibit the broadcasting of compatible color television signals.[8]

1. THE COMMISSION MAY, ON ITS OWN MOTION AND WITHOUT HEARING, INTERPRET ITS EXISTING RULES TO PERMIT THE BROADCAST OF COMPATIBLE COLOR TELEVISION SIGNALS

In 1941 the FCC first set technical signal standards for black-and-white television broadcasts. These signal standards were included in the FCC Standards of Good Engineering Practice.

The NTSC signal specifications for compatible color television broadcasts include, in general, the Commission's standards for black-and-white television broadcasts. Because of that fact all black-and-white television receivers can receive NTSC color signals in high quality black and white. Thus the NTSC technical signal specifications are, in effect, the FCC black-and-white technical standards with a "plus factor" which gives color to compatible color television receivers.

The fact that the NTSC technical signal specifications for compatible color contain additional information beyond that explicitly required by the existing

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[7] *In re Application of Ozarks Broadcasting Company* (5 Pike & Fischer Radio Regulation cases 1305, 1315 (1950)).

[8] The points made in this memorandum were not determined by the Supreme Court in *Radio Corporation of America et al.* v. *The United States of America et al.* (341 U. S. 412 (1951)).

In that case the Supreme Court determined that the FCC had not abused its discretion in refusing to adopt specific standards for compatible color television. In this memorandum we point out that it is within the Commission's discretion to permit the broadcasting of compatible color television signals on its own motion and without hearing.

FCC rules relating to black-and-white transmission does not require the Commission to hold that broadcasting the NTSC signal is not sfficient compliance with the FCC Standards of Good Engineering Practice.

The Commission can, in its discretion, issue a construction of its rules specifically providing that it will be compliance with the Commission's black-and-white television transmission standards to broadcast a signal which generally includes these standards and which can be received in black and white on all existing television sets without alteration. The NTSC tentative signal specifications would fall within this construction.

The Administrative Procedure Act does not require that the issuance of an interpretative construction be preceded by any hearing or other rulemaking proceding. For that reason the Commission has authority to issue on its own motion an interpretation that broadcasts in accordance with NTSC signal specifications comply with already existing monochrome standards of the Commission.

2. THE COMMISSION MAY, ON ITS OWN MOTION AND WITHOUT HEARING, MODIFY ANY OF ITS EXISTING RULES WHICH MIGHT PROHIBIT THE BROADCASTING OF COMPATIBLE COLOR TELEVISION

In addition to issuing a new construction of its rules, the Commission may, on its own motion and without hearing, modify whatever FCC rules it believes should be modified in order to permit commercial broadcasting of NTSC signal specifications in addition to the broadcasting already expressly permitted by FCC rules.

This action by the Commission would not require any notice and rulemaking procedure because section 4 of the Administrative Procedure Act specifically provides that no notice and rulemaking proceeding are required where such action is either impracticable, unnecessary, or contrary to the public interest.

We believe that any procedures which may delay the advent of compatible color television broadcasting are contrary to the public interest and thus fall squarely within the terms of section 4 of the Administrative Procedure Act.

Further, it is, under the terms of section 4 of the Administrative Procedure Act, unnecessary for the FCC to have a notice and rulemaking proceeding because the compatibility aspect of the NTSC technical signal specifications is already well known to the members of the Commission and its technical staff. The National Television System Committee has kept the Commission and its staff advised of the progress of its work and has sent to the Commission records of its proceedings, including studies prepared by its members.

If, in addition to modifying existing standards to permit the immediate commercial broadcasting of compatible color, the FCC should desire to go further and promulgate formal color standards based on the NTSC signal specifications, section 4 of the Administrative Procedure Act permits this action to be taken by the Commission on its own motion and without hearing, simply on the basis of giving notice and receiving written comments. This procedure could be supplemented by an informal engineering conference if desired.

Although by its public notice 65008 of June 11, 1951, the Commission announced an involved and lengthy procedure as a condition precedent to promulgating standards for an additional type of color television broadcasting, this public notice can be withdrawn in precisely the same informal way in which it was issued.

Respectfully submitted.

ROBERT L. WERNER,
Vice President and General Attorney, Radio Corporation of America.
EUGENE E. BEYER, JR.,
RAY B. HOUSTON,
JOHN H. BERMINGHAM,
Of Counsel.

MARCH 24, 1953.

The CHAIRMAN. Are there any questions?

Mr. HINSHAW. Mr. Chairman.

The CHAIRMAN. Mr. Hinshaw.

Mr. HINSHAW. Dr. Engstrom, you have made a very fine statement. It is very complete, so far as the position of the Radio Corporation of America is concerned.

I understand that there are others engaged in developing a compatible system of television broadcasting and receiving. Is that true?

Dr. ENGSTROM. I think first, sir, that before I can answer that question we will have to define what we mean by "a system."

The industry engineers are working together to come to an agreement as to what the characteristics should be of the signal to be transmitted.

Now, using that signal, we in RCA and others in their laboratories are developing and working with a system of apparatus which we may call by various names and which will, when those signals are received, produce pictures in color. To that extent there are a substantial number of organizations in this country, working on compatible television.

Mr. HINSHAW. And they are not necessarily based on the same electronics system which is used by RCA?

Dr. ENGSTROM. They need not be, but they all are striving so that the signals will be receivable on their equipment.

Mr. HINSHAW. Now, whether the specifications or the standards that RCA proposes to be adopted are suitable to other systems of compatible television broadcasting is the next question.

Dr. ENGSTROM. We expect to process the NTSC signals for adoption. We propose that the signals specifically agreed upon by the National Television Systems Committee be the one that the Federal Communications Commission adopt.

Hr. HINSHAW. Well, that is not quite the answer to it.

Dr. ENGSTROM. Then, I am sarry, sir. I do not understand you.

Mr. HINSHAW. I say, is the standard proposed by NTSC suitable to all the systems of color television broadcasting that appear to be possible?

Dr. ENGSTROM. It is difficult for me, sir, to answer for other people; but I would assume from what has taken place that these signals are satisfactory to the parties who are participating in the NTSC work and that involves some people who are employed by some 30 compnies in the United States directly on the committee and some 26 additional companies involved in the work of the panels.

Mr. PRIEST. Will the gentleman yield for one question?

Mr. HINSHAW. I will yield.

Mr. PRIEST. Has there been any general agreement on the character of the signal, that is, any general agreement among all of these different companies or corporations that might be working on this one problem.

Dr. ENGSTROM. Oh yes, there has been an agreement.

Mr. PRIEST. There has been an agreement as to the general characteristic of the signal.

Dr. ENGSTROM. There has been an agreement, but I think I should amplify that just a little bit. There was the first agreement in the fall of 1951 on a set of signals which we all wanted to go ahead on, on field tests. We felt that we should test them for a period of a year, and then, we came together again, and made certain notations of the facts in the light of the experience that we had had and revised specifications were agreed upon in February of this year and now we believe that we are in the final field tests. Now, there may be some slight changes, but we are in agreement as to what the situation ought to be for a compatible color television system.

The CHAIRMAN. At this point, I think it might be appropriate if you would insert the names of those who are members of the National Television Systems' Committee, so that the committee will have the benefit of knowing the worthwhile character of the committee, composed as it is of so many outstanding scientists, research workers, manufacturers, and others interested in this particular phase of television.

Dr. ENGSTROM. Mr. Chairman, suppose I leave with the reporter this morning, this incomplete list, because what I have with me is the membership of the committee itself, not the membership of the sponsoring panels and I am sure that Dr. Baker will bring that entire list with him when he appears on Friday.

The CHAIRMAN. Very well.

(The list referred to is as follows:)

NATIONAL TELEVISION SYSTEM COMMITTEE

Chairman: W. R. G. Baker, General Electric Co., Electronics Park, Syracuse, N. Y.
Vice chairman: A. V. Loughren, Hazeltine Electronics Corp., 58-25 Little Neck Parkway, Little Neck, L. I., N. Y.
Vice Chairman: D. B. Smith, Philco Corp., Tioga and C Streets, Philadelphia, Pa.
Vice Chairman: E. W. Engstrom, RCA Laboratories, Princeton, N. J.
Secretary: Mrs. Martha Kinzie, General Electric Co., Syracuse, N. Y.
Legal adviser: Mr. R. M. Estes, General Electric Co., Syracuse, N. Y.
Legal adviser: Mr. Philip Dechert, Philco Corp., Tioga and C Streets, Philadelphia, Pa.

Organization	Representative	Alternate
American Broadcasting Co., 30 Rockefeller Plaza, New York, N. Y.	Mr. Frank Marx	Mr. Robert Morris.
Admiral Corp., 3800 Cortland St., Chicago 47, Ill.	Mr. Rinaldo DeCola	Mr. Robert M. Jones, 550 College Ave., Palo Alto, Calif.
Ratheon Television Radio Corp., 5921 West Dickens Ave., Chicago 39, Ill.	Mr. Hugh Christian	Mr. Howard Gronemier.
Bendix Radio Division, Baltimore, Md	Mr. A. C. Omberg	Mr. John Miller.
Baltimore Sun, Station WMAR-TV, Baltimore, Md	Mr. E. K. Jett	Mr. C. G. Nopper.
Chromatic Television Labs., Inc., Paramount Bldg., Times Square, New York, N. Y.	Mr. Richard Hodgson	Mr. Robert Dressler.
Color Television, Inc.	Mr. Robert J. Stahl, Color Television, Inc., 973 San Carlos Ave., E., San Carlos, Calif.	Mr. Samuel Smith, Lippincott & Smith, 24 California St., San Francisco, Calif.
Crosley Division, AVCO, Manufacturing Corp., 1329 Arlington St., Cincinnati 25, Ohio.	Mr. Lewis M. Clement	Mr. P. F. G. Holst.
CBS-Columbia Inc., 170 53d St., Brooklyn 32, N. Y.	Mr. Leopold Kay	Mr. Israel J. Melman.
Allen B. DuMont Lab., Inc., 750 Bloomfield Ave., Clifton, N. J.	Dr. Allen B. DuMont, president.	Dr. T. T. Goldsmith.
Emerson Radio & Phonograph Corp., 111 8th Ave., New York 11, N. Y.	Mr. D. D. Israel	Mr. R. T. Capadonno.
Federal Telecommunications Laboratories, Inc., 500 Washington Ave., Nutley 10, N. J.	Mr. M. Silver	Mr. N. H. Young.
General Electric Co., Electronics Park, Syracuse, N. Y.	Mr. I. J. Kaar, Manager of Engineering.	Mr. J. E. Keister.
General Teleradio, Inc., Station WOR, 1440 Broadway, New York, N. Y.	Mr. N. F. Smith	Mr. C. D. Samuelson.
Dr. Alfred N. Goldsmith, 597 Fifth Ave., New York, N. Y.	Dr. Alfred N. Goldsmith.	Mr. D. E. Hyndman, Eastman Kodak Co. 343 State St. Rochester, N. Y.
The Hallicrafters Co., 4401 West Fifth Ave., Chicago 34, Ill.	Mr. Harold J. Adler	Mr. Leo R. Mead.
Hazeltine Electronics Corp. 58-25 Little Neck Parkway, Little Neck, L. I., N. Y.	Mr. A. V. Loughren, Vice President.	Mr. Knox McIlwain.
Hogan Laboratories, Inc., 155 Perry St., New York, N. Y.	Mr. J. V. L. Hogan, President.	Mr. Frank A. Hester, Chief Engineer.
The Magnovox Co., Fort Wayne 4, Ind.	Mr. John A. Rankin	Mr. Frank Norton.
Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.	Dr. Dan E. Noble	Mr. E. B. Passow.

Organization	Representative	Alternate
McGraw-Hill Publishing Co., 330 West 42nd St., New York, N. Y.	Mr. William McDonald.	Mr. Vin Zeluff.
Philco Corporation Tioga and C Sts., Philadelphia, Pa.	Mr. D. B. Smith	Mr. F. G. Bingley.
Radio Corporation of America	Dr. Elmer Engstrom, RCA Laboratories, Princeton, N. J.	Dr. G. L. Beers, RCA Victor Division, Camden, N. J.
Sentinel Radio Corp., 2100 Dempster St., Evanston, Ill.	Mr. W. J. Schnell	Mr. Joyce J. Jackson.
Sylvania Electrical Products, Inc., 1740 Broadway, New York 19, N. Y.	Dr. R. M. Bowie, Director of Engineering.	Mr. B. F. Tyson, Sylvania Center, Box 6, Bayside, L. I.
Tele-King Corp., 601 West 26th St., New York, N. Y.	Mr. Jerome Bresson	Mr. Paul Neuworth.
Tele-Tech, Caldwell-Clements, Inc., 480 Lexington Ave., New York 17, N. Y.	Dr. A. F. Murray, 4707 Windom Pl., Washington, D. C.	Dr. O. H. Caldwell, editor, Tele-Tech.
Tele-Tone Radio Corp., 540 West 58th St., New York, N. Y.	Mr. M. L. Levy, Bayway Terminal, Amboy Ave., Elizabeth 2, N. J.	Mr. R. S. Mautner.
Westinghouse Electric Corp., Baltimore 3, Md	Mr. Ralph Harmon, Westinghouse Radio Stations, 1625 K St. NW., Washington 6, D. C.	Mr. M. R. Briggs.
Zenith Radio Corp., 6001 Dickens Ave., Chicago 39, Ill.	Mr. Joe Spindler	Mr. J. E. Brown.

The CHAIRMAN. Now, I suggest that each member as we question the witness be permitted to conclude his questions, in view of the fact that at times the questions may take on more or less technical aspects, and it might be well for the particular member to be permitted to finish his questioning.

Mr. HINSHAW. Mr. Chairman.

The CHAIRMAN. Mr. Hinshaw.

Mr. HINSHAW. In view of the fact that we appear to be moving in the direction of at least 2 if not 3 or 4 systems of color broadcasting, perhaps all but 1 of which will be compatible, do you not think that it is desirable that we end up with systems or a system that is receivable by all receivers that are manufactured?

Dr. ENGSTROM. Yes, I surely do, because that is the principle upon which broadcasting has developed in this country.

Mr. HINSHAW. Exactly. And, in view of the fact that there are other manufacturers and people engaged in research who are endeavoring to manufacture a compatible tube or receiving tube, should not all of these be adequately tested before one of them is accepted as final?

Dr. ENGSTROM. I think, sir, that I am not clear on the matter of standards, when we bring in apparatus, because I like to think of standards as being the character of the signal that is broadcast and available at the receiving antenna and I do not believe that there are any instances where equipment needed to go into the standardization as such is not available. Now, you made mention of the color tube. Color tubes can be made so that they can work on the signal which is recommended by the National Television System Committee, or they can be made to work on other signals if one should choose.

Now, the National Television System Committee, as I am sure will be explained on Friday, is open and available to anyone in this country to appear and to join in the work. Of all the people who have joined in the work, I believe we are clear that the standards which we are now pursuing, we believe in the final field testing, meets the desires of what people wish to have in that transmitting signal for a compatible color-television signal.

Mr. HINSHAW. Will that signal be satisfactory to other systems than your own?

Dr. ENGSTROM. We understand so; and we believe so; yes.

Mr. HINSHAW. You believe that it will be satisfactory?

Dr. ENGSTROM. We believe it will be satisfactory. There is a difference, sir, between what is a standard, that requires the action of the Federal Communications Commission and the apparatus which a manufacturer will make in order to utilize that signal and I think that those are completely separate things.

Now, it is true, of course, that when this signal is established, one must build apparatus which fits within a certain pattern; but that pattern should not be restrictive. It should be as broad as possible in order that companies may make the equipment in their own way and use the results of their own development.

We believe, those of us who are participating in this, in the NTSC work, but the National Television System Committee standards are just that, in the same way as we have now found by experience that the black-and-white standards which were certified in 1941, have given us this freedom to proceed, so that the public has an acceptable television, the acceptable television that it has.

Mr. HINSHAW. Do the manufacturers at present use a black-and-white tube for reception by the receivers?

Dr. ENGSTROM. For the color picture?

Mr. HINSHAW. No.

Dr. ENGSTROM. I am sorry, sir.

Mr. HINSHAW. A black-and-white tube for the black-and-white receiver.

Dr. ENGSTROM. Yes; they do.

Mr. HINSHAW. That comes under common patent rights?

Dr. ENGSTROM. There are many organizations that have patent rights.

Mr. HINSHAW. Basic patents then.

Dr. ENGSTROM. I am not sure that I understand what is meant by a basic patent.

Mr. HINSHAW. A basic patent on the present tube, receiving tube.

Dr. ENGSTROM. There are enough patents of enough importance so that people who wish to use those patents in the making of a black-and-white receiving tube—and my company is the holder of a number of those patents and there are some held by others——

Mr. HINSHAW (interposing). Who holds the original basic patent?

Dr. ENGSTROM. That was done too long a time ago to be in existence today. But, from a practical point of view——

Mr. HINSHAW. Does that mean that the patent is in the public domain?

Dr. ENGSTROM. The basic patent with respect to the cathode ray tube is in the public domain, yes; but the niceties of design, niceties of manufacture, which make for the commercial tube—there are existing patents on those tubes.

Now, when we talk of a color-television tube, that may be different, because of this research and development, which is of more recent origin.

Mr. HINSHAW. Then the basic pattern of the color tube is not in the public domain?

Dr. ENGSTROM. I believe that that is correct, sir. There are some that are, but I think that is correct.

Mr. HINSHAW. That is all, Mr. Chairman.

Mr. PRIEST. Mr. Chairman.

The CHAIRMAN. Mr. Priest.

Mr. PRIEST. Doctor, I take it from this brief submitted by your legal staff, that it is your position that the Federal Communications Commission may on its own motion and without any hearing issue an order to modify their previous decision and permit compatible television broadcasting.

Dr. ENGSTROM. We believe so; yes.

Mr. PRIEST. I am inclined to that same position.

I want to ask you this further question, in that respect: Has there been any indication that the Commission might on its own motion and without hearing issue such a modification of their previous order?

Dr. ENGSTROM. The only thing we have, sir, is the published notice that came out at the time that that authorization was given to broadcast by the sequential incompatible signal. At that time they said, "We have not closed the door to such system, particularly compatible signals."

Here is the criteria which must be met. At the time a proponent for such a system presents a request for a hearing, we are all operating under the assumption that that is the procedure; but we do believe as this memorandum of law indicates, that the Commission may, on its own motion, proceed.

Mr. PRIEST. I think there is ample authority in the statute for the Commission to follow that procedure if it so desires.

In the event that the Commission does not on its own motion, I understand then that RCA plans within the very near future to file a request for a hearing.

Dr. ENGSTROM. Yes; that is correct; we do expect to.

Mr. PRIEST. Within——

Dr. ENGSTROM. Six months or less.

Mr. PRIEST. Within 6 months or less?

Dr. ENGSTROM. Yes.

Mr. PRIEST. Mr. Chairman, that is all at this time.

Mr. O'HARA. Mr. Chairman.

The CHAIRMAN. Mr. O'Hara.

Mr. O'HARA. Doctor, coming from the land where the Engstroms speak to the Olsons and the Olsons speak to the Johnsons, and they all vote for O'Hara, I am very happy to welcome another good Scandinavian.

Dr. ENGSTROM. May I add, sir, that the old saying is modified in Minnesota, that we all speak to each other.

Mr. O'HARA. That is right.

Dr. Engstrom, perhaps I could gather more information by listening, but I want to put the question to you: As a result of the Commission's order on the incompatible system, has there been a general sitdown strike, so far as the manufacturers, generally speaking, are concerned as to the development of apparatus for carrying out the Commission's order; or is it the fact that the engineering brains of our country just do not feel that the incompatible system is the right one?

Dr. ENGSTROM. May I take that in several parts?

Mr. O'HARA. You may take it in as many parts as you want.

Dr. ENGSTROM. Yes. So far as the members of the technical staff of the Radio Corporation is concerned, we were convinced when we were before the Commission and giving our testimony that it would be a mistake to establish a system which was incompatible with black and white and we had some of the characteristics, the limitations of the signal from the point of view of the technical end, and we saw the great possibilities. We naturally recommended within our own organization that it would be unwise for us to invest our money and to sell things to the public on that kind of a system.

Now, on that we are clear, and on that we made our recommendations, and we made our statement to the Commission as to what we proposed to do.

Now, as to what the rest of the industry intends to do or what they did not intend to do at that time I, of course, do not know; but a substantial number of technical and professional witnesses appeared before the Commission stating also that they thought it would be a mistake to adopt any incompatible standards.

Mr. O'HARA. Now, as the result of that order, even taking into account the restriction which was placed upon it by the NPA, for a certain time, do you feel that there will be any general progress in the development and manufacture of the incompatible system which presently exists under the order of the Federal Communications Commission?

Dr. ENGSTROM. Well, sir, this committee is going to hear tomorrow, of course, from the president of the company that was a proponent of the other system. I will give my own view.

Mr. O'HARA. I would like to have it.

Dr. ENGSTROM. That the day is passed; the ship has sailed; there are almost 23 million receivers in the hands of the public today, and I would not want to invest any of my money in producing a system that could not be received on those receivers.

Mr. O'HARA. Now, Doctor, would there be the necessity even under your system of the owners of the present television sets, would they have, or would they probably have to purchase a tube which would receive the color television?

Dr. ENGSTROM. Now, sir, we are getting into a question where I think there is a little experience in what the American people do.

I do not believe that you or I will rebuild the set or modify the set that we have in our home today.

When automatic transmission became available on automobiles, we traded in the car we had, if we wanted a car with that facility. I think that that same thing will happen in television.

On the other hand, there will be the possibility of selling additional units which would provide the picture in color for the man who has a black and white set; but that runs into difficulties; the placement of parts and things of that kind.

So that while I am sure it will be done during the transition period, I think that what they probably will do will be to use their black and white pictures, continue with their black and white programs and color programs until they decide to spend the money to buy a new receiver and then turn the one they have in on a new one, or put it into secondary service.

I do not believe that many people will buy attachment to rebuild their sets. That is my opinion.

Mr. O'HARA. That is all.

Mr. HARRIS. Mr. Chairman.

The CHAIRMAN. Mr. Harris.

Mr. HARRIS. Doctor, I think I understand some of the difficulties that you have explained in your statement here, but it is not altogether clear to me what the implications are.

Now, as to the difference between compatible and incompatible television, so far as the effect on the receiver is concerned, I can understand that; but otherwise it is not altogether clear. Will you give us a little more, or a little clearer definition of the two?

Dr. ENGSTROM. I shall try. In order that all of the receivers in the country may be able to receive the black and white transmission by the sets now available, the Federal Communications sets standards as to the number of lines—these horizontal lines that you can sometimes see in the picture—and the number of complete pictures per second.

In the compatible color television system which we are developing, we retain those same characteristics, so that when that signal is impressed on today's black and white receiver, the receiver knows just what to do, because the number of lines are the same and the number of pictures are the same, sent at the same rate.

Now, when one goes to color one has to transmit more information than is required in black and white, and if it is done by the sequential method—in other words, devoting the transmission type at one instance blue, and for another short time red, and another short time green, you have to have this happen more often than you do black and white. So, therefore, the receiver does not get a signal, unless you have the same number of kilocycles, and the same number of pictures that you had with the black and white; and in transmission, if you find there are not as many lines in the picture, so the receiver does not have the ability, in the circuit, which permits it to operate over that very wide range and, therefore, the receivers do not give a picture, unless it is modified.

Now, again, going back to the compatible signal, because we retain the same characteristics that were broadcast in black and white, or if we do not retain those we do not give a picture in black and white, without modification.

Mr. HARRIS. In other words, the proposition, technical as it is, is in the transmission.

Dr. ENGSTROM. It is in the transmitting of the signal.

Mr. HARRIS. And the effect it has on the receiving set.

Dr. ENGSTROM. That is correct.

Mr. HARRIS. That is all. Thank you, Mr. Chairman.

Mr. HALE. Mr. Chairman.

The CHAIRMAN. Mr. Hale.

Mr. HALE. Well, along that same line, I want some more enlightenment as to the term "field sequential" as it appears quite frequently in your statement.

Dr. ENGSTROM. Yes, sir.

In a sequential system in order that the picture may be brought in clearly, we devote a short period of transmission to sending information that is representative of the red primary; next, the green primary, and next the blue primary, and when we combine those three

signals, if they are all on we have white. If they are all off we have black. If there is more red, then we have a pink; a characteristic of red. So, we can mix the three colors and get essentially any of the hues to which our eyes respond.

Now, in the compatible system, we send that information essentially all at the same time. So, it is simultaneous and because it is simultaneous we can retain, as I have just explained, the simultaneous characteristics which were set up for black and white, and add something to it.

Mr. HALE. The alternative to the field-sequential system is a simultaneous system, is that right?

Dr. ENGSTROM. It is simultaneous, or it is a form of very rapid sequential, but the system we have today is essentially simultaneous; yes, that is right.

Mr. HALE. That is all, Mr. Chairman.

Mr. HESELTON. Mr. Chairman.

The CHAIRMAN. Mr. Heselton.

Mr. HESELTON. Doctor, in the letter which is exhibit B of your statement, signed by C. B. Jolliffe, addressed to Senator Tobey, I notice a quotation from a letter from Dr. Baker:

> The primary objective of this committee was to attempt to create a practical color transmission which would utilize as a foundation, the existing monochrome transmission standards. All interests involved in this issue, including the FCC as well as other system proponents, have unanimously agreed on the desirability of this objective. They have only disagreed on which—and when— it is possible of attainment.
>
> If it is possible to base color on the current monochrome standards, then this important improvement in this service can be realized without reducing the value of a single one of the millions of television receivers owned by the American public.

That is the end of the quotation. Then Mr. Jolliffe wrote:

> We believe that this has been achieved.

I understand that others do not agree with that.

Dr. ENGSTROM. May I say, I cannot give you a no answer to that; I cannot give you exactly a yes answer, and I am going to explain why.

In reference to the background which obtained during the hearings of 1949 and 1950, the National Television System Committee, which is a group of engineers as individuals—they came to the conclusion that we now have signal characteristics which do meet these requirements and what stands between us and the end result, so far as this industry group is concerned, is our field tests which are now in process and which should not last long.

Mr. HESELTON. That brings me to this thought, calling your attention to a statement which I have before me, in terms of what the chairman described as the optimism with which you spoke this morning.

Dr. ENGSTROM. Yes, sir.

Mr. HESELTON. It is (reading):

> If current comment is any indication, color television remains a long way off. The latest expression comes from Dr. W. R. G. Baker, chairman of the all-industry group, the National Television Standards Committee, which has been at work nearly 2 years to devise acceptable standards for a compatible system—one that would fit into and not disrupt the present black-and-white operation.
>
> As quoted by Radio Daily, trade publication, he said, "I have no opinion as to when color TV will be launched full scale. Until extensive field and operating tests have been conducted to locate all possible faults any guess on commercial color TV as a home service would be premature and without foundation."

That struck me as being rather in contrast to the testimony that you have given this morning. I would like to have your comments on it.

Dr. ENGSTROM. May I ask whether that news release indicates Dr. Baker is speaking as a representative of the General Electric, an industry company, or what it indicates.

Mr. HESELTON. It just says Dr. Baker is chairman of the all industry committee. It does not indicate in what capacity he is speaking.

Dr. ENGSTROM. I have indicated this morning this optimistic viewpoint, because in all sincerity we believe we are at the point now in color television where the proper thing to do is to move into commercial operations. We do have ahead of us some field tests. We are more optimistic possibly than some of the others because we have had more experience. We have had more assurance. We have had more knowledge, but the NTSC is a technical body and is making these field tests, and when they are finished we expect to have the data which will substantiate the situation and we will be in a position for submission to the Federal Communications Commission.

Now, if Dr. Baker has made that statement with respect to the NTSC then, I desire to have a discussion with him at the next meeting, because I am more optimistic than he indicates, and I do not share those views.

Mr. HESELTON. That is all.

Mr. CARLYLE. Mr. Chairman.

The CHAIRMAN. Mr. Carlyle.

Mr. CARLYLE. What about the people who now own receiving sets? Will they be able with their sets to receive the color television broadcasts in black and white?

Dr. ENGSTROM. Black and white; that is correct.

Mr. CARLYLE. So that for them to use those sets, of course, you take the position that it would not be practical to add some attachment, but that they would in all probability be traded in.

Dr. ENGSTROM. I think that will be the outcome; but I think the public will be offered the choice.

Mr. CARLYLE. Well, what about the quality of the black-and-white picture under this new procedure; would it be effective?

Dr. ENGSTROM. We believe not, sir.

Mr. CARLYLE. Well, how many receiving sets did you say there were now in the country?

Dr. ENGSTROM. There are almost, as of today, almost 23,000,000 sets in the hands of the public.

Mr. CARLYLE. That is the best estimate?

Dr. ENGSTROM. Yes, sir.

Mr. CARLYLE. How long would it require to make the turnover, that is, the people now having receiving sets, by either trading them in or having them changed?

Dr. ENGSTROM. I am speaking, sir, of the time when an equivalent number would have color sets.

Mr. CARLYLE. That is correct.

Dr. ENGSTROM. I can only say what happened in the same way in which black-and-white grew. They first sold black-and-white sets in 1946. Here we are in 1953 and we have 23,000,000 sets in operation. It would go through a cycle of that kind.

Mr. CARLYLE. Of course, it would be very gradual.

Dr. ENGSTROM. Yes. But the important thing, sir, if it is a compatible system, you may develop gradually. You will have no shock when you make the change.

Mr. CARLYLE. What is the difference in cost between a black-and-white set and a color-receiving set?

Dr. ENGSTROM. Naturally we are getting, sir, into the place where we are actually going to have an apparatus on the market. We do not have the exact cost in order to provide color; one must have more circuits really in service than you have for black and white. So it is inherent that a color receiver will be more costly than a black-and-white receiver.

Now, I am not sure that I can give you an estimate that is significant. I am going to refer to the statement I made during the course of the hearings. But, let us look at what happened to the few sets that were produced and offered. The statement before the Commission was that they would be offered at about $300. When they came on the market they were nearer $600, with the installation and other things. Now, there is nothing wrong with that. That $600 figure was probably a correct figure and I expect that the people at that price who made the sets lost money, as I expect that all of us are going to lose money on the first 25,000 sets or so we make.

Now, I indicated during the hearings that I thought that when we got into mass operations on color television that we could expect that a color set would cost approximately 50 percent more than a black-and-white set and that that would reduce, be reduced, as we go along and might someday get as close as not more than 25 percent; but I cannot see any possibility of them being the same, because one must do more in order to have color.

Mr. CARLYLE. Now, doctor, you have made some very helpful statements and you impress me as knowing your subject.

I understand that a black-and-white receiving set will receive the program, and perhaps you can get 100 percent of the program if the set is not removed more than 40 miles from the broadcasting station. Is that correct?

Dr. ENGSTROM. Are you asking whether there is any difference in the way that set will respond, whether it is a black-and-white set or it is a color set?

Mr. CARLYLE. Yes; the black-and-white as compared with the color.

Dr. ENGSTROM. Our tests have indicated that the receiving range will be the same; but when a color program is being transmitted and when a black-and-white signal is being transmitted, our indication is that the service range will be the same.

Mr. CARLYLE. Now, I heard your explanation of why it would not be practicable or advisable to use the attachment on a black-and-white set for conversion of that set to a color set.

In the event there are some that may care to add the attachment, about what would that attachment cost?

Dr. ENGSTROM. Let me put it this way: If one added to the price of the attachment the price of the lack-and-white receiver that had been purchased originally, the sum of the two would be greater than the cost of buying a color receiver, because for instance they have made millions of black-and-white sets.

Now, as to what it would cost, I cannot tell you that, sir. I would expect that one of the difficulties would be that the desire for that

attachment would come during the early days when the cost of all color equipment is high and, therefore, I would expect he would pay far more for it at that time than he paid for his black-and-white set originally.

The CHAIRMAN. It may be that the witness who appears tomorrow will be able to give that.

Mr. CARLYLE. That is all, Mr. Chairman.

Mr. DOLLIVER. Mr. Chairman.

The CHAIRMAN. Before you proceed, Mr. Dolliver, may I make inquiry as to how many members of the committee wish to question the witness? I have in mind that he can either continue now sufficiently long to enable all to do so or we can return at 2 o'clock. All of those who have a desire to question the witness will please indicate it. It seems to me that if the questioning is not too long we would be able to conclude, so we will have the afternoon free. If there is no objection on the part of the committee we will proceed in an effort to conclude this morning.

I have in mind bringing a bill before the committee that will take about 2 minutes to dispose of, if you care to stay long enough and keep a majority of the committee present to do that.

We will proceed with the questions.

Mr. Dolliver, you may proceed.

Mr. DOLLIVER. I, too, Dr. Engstrom, want to compliment you on the very fine and comprehensive statement you have made.

I am a little puzzled by the statement on page 10, top of that page wherein you refer to a broader channel used by RCA in its demonstrations of all-electronic simultaneous color television.

Do I understand that originally it took more than a 6-megacycle band to transmit color?

Dr. ENGSTROM. Yes; it took more than 6 megacycles for color television.

Mr. DOLLIVER. How many megacycles did it take?

Dr. ENGSTROM. From 12 to 14 megacycles, at the time, 1946 and 1947, when we were working in that area.

Mr. DOLLIVER. In the meantime have you not brought your system within the limitation of 6 megacycles, which is the FCC standard?

Dr. ENGSTROM. Very definitely and that is a part of the NTSC's expectation.

Mr. DOLLIVER. That is a part of the expectation and you definitely have accomplished that now?

Dr. ENGSTROM. Yes.

Mr. DOLLIVER. That, of course, is of very great importance so far as a widespread use of color television is concerned.

Dr. ENGSTROM. That is right.

Mr. DOLLIVER. I notice further in some place you indicate that the color television can be transmitted from place to place by an addition to the system of the A. T. & T. on the coaxial cable. Has that been thoroughly tested?

Dr. ENGSTROM. It has been thoroughly tested, as thoroughly as we can. We have had repeated transmissions over the Bell System.

Mr. DOLLIVER. I beg your pardon, but I did not get that.

Dr. ENGSTROM. We have had repeated transmissions by the Bell System facilities, using their equipment with their cable.

Mr. DOLLIVER. And you are satisfied that clear color transmission can be had over the coaxial cable system?

Dr. ENGSTROM. Yes, sir.

Mr. DOLLIVER. Is there any other method of transmitting?

Dr. ENGSTROM. The microwave.

Mr. DOLLIVER. And the microwave is satisfactory?

Dr. ENGSTROM. That is the present system in terms of miles in the United States now, and that system will take the color signal as it is without any change.

Mr. DOLLIVER. It needs no modification?

Dr. ENGSTROM. It needs no modification.

Mr. DOLLIVER. Who is responsible for operating the microwave?

Dr. ENGSTROM. The Bell Telephone System.

Mr. DOLLIVER. It is coordinated with their coaxial cable?

Dr. ENGSTROM. They use both the radio and cable network. They use whichever one they think is right to meet the conditions under the particular circumstances that they have to deal with—the terrain and the load and all the rest of it.

Mr. DOLLIVER. Now, there has been one technical feature of this television broadcasting which has had me puzzled a great deal.

We are told that the signal goes in a straight line and does not follow the curvature of the earth, and yet I have read of examples where there have been reception of television at vast distances; far greater than could be received if the signal followed just the curvature of the earth.

Dr. ENGSTROM. Yes, that is correct.

Mr. DOLLIVER. Can you explain that?

Dr. ENGSTROM. Nature never does anything in a simple way. So that is the first approximation, these signals do go in a straight line from the transmitter antenna to the horizon, but there has been bending.

Mr. DOLLIVER. There is bending?

Dr. ENGSTROM. There is bending. But, the difficulty is that it is not certain enough nor is it constant enough so that one can use it very far beyond that horizon.

Mr. DOLLIVER. Do you know what is the cause of the bending?

Dr. ENGSTROM. Yes. Yes, it could be any one of several things. It can be bending as the result of ionized lines of the atmosphere acting like lenses, as they do on radio wavelengths.

Mr. DOLLIVER. They bounce off something?

Dr. ENGSTROM. Now, the television beam bends like a light wave does that goes through a glass lense, or the wave can hit a sharp peak of a mountain, and just as a light wave bends it goes over a very sharp area, so will the radio signal bend and come down.

Now, these signals that are transmitted over very long distances are bent back from one of the very high layers above the atmosphere. There are times for example, a few months in every 7 years when we can spasmodically hear the signals, television signals from England, but it is not the kind of a signal that gives us any service, because we do not know exactly when it will happen or how long it will continue. So, we can very readily recognize that a television station has a service area that has been mentioned of 40, 50, or 60 or 70 miles, depending upon where the antenna is located. If it is located on top of a mountain it will have a rather wide service area. It might be 100, or more,

or 200 miles. An antenna 500 feet up on an airplane might not go much more than 40 or 50 miles.

Mr. DOLLIVER. Is there a differential between the range of the very high frequency and the ultra high frequency signal?

Dr. ENGSTROM. There is in a practical sense, because the ultra high frequency signals are more disturbed by the surroundings in the vicinity of the receiving antenna. If you have the receiving antenna in a wooded area, you will get a better signal in winter than summer, because of the leaves. Buildings have more effect on ultra high frequency than they do have on VHF. So, it would not depend upon the system. One must take into account the way that the wavelength is propagated from the transmitter to the receiver.

Mr. DOLLIVER. Is there any difference in quality of receiving of the ultra high frequency and the very high frequency?

Dr. ENGSTROM. No, sir. If the signal comes through in the strength required they are identical. The only difference is in the extraneous interferences.

Mr. DOLLIVER. I remember a few years ago seeing a demonstration of the CBS system; the sequential system, I think they called it, and also the demonstration of the tube, I believe, produced by the RCA. I was impressed by both of them, of course, being a layman and not knowing the technical details of them; both I think produced good color.

I do recall that in the RCA demonstration the demonstration was made at a downtown studio of NBC here, and it was a compatible system, because they had a black-and-white receiver right beside the color receiver, but they did say that at that time wire connections were used between the Wardman Park Hotel and the receiving set there in the downtown studios.

Now, I assume at this time that there has long since been obviated the necessity of any wire connections in the sense that it was used at that titme for demonstration purposes.

Dr. ENGSTROM. There is no problem as to whether it goes by radio or whether it goes by cable. I expect when you saw it it was at the time of day when they were not permitted to broadcast.

Mr. DOLLIVER. I assume that there was some reason of that kind which was involved.

Dr. ENGSTROM. Because when the Commission issued its order setting the present color standards, there were two requirements to be met for experimental work with color. One was that we transmit out of hours—in other words, from midnight to 5 o'clock in the morning, and much of our transmission has been done during those hours. We do ask special permission to operate at special times. We do that also.

Mr. DOLLIVER. Now, there is one problem which particularly interests me, coming as I do, from a rural area. We have some television stations going up all through the country, of course.

Now, when they equip themselves for black and white transmission and then in a year, 2 or 3 or 4 years, they come along and find that color transmission is coming on the market, is it going to be a tremendously difficult and expensive thing for them to change to color transmission in those rural areas?

Dr. ENGSTROM. Well, let us explore what they have to do. They will do nothing to their transmitter or antenna. That will stay the

same. They will need color cameras and some associated color equipment if they wish to transmit color, and a color studio.

Mr. DOLLIVER. A color studio?

Dr. ENGSTROM. A color studio so that they can produce color programs. They will have to reequip a studio for color.

Mr. DOLLIVER. That is locally?

Dr. ENGSTROM. That is locally.

Mr. DOLLIVER. For local transmission.

Dr. ENGSTROM. That is right.

Mr. DOLLIVER. But, they will need no alterations to receive color, we will say, from Chicago or New York or elsewhere?

Dr. ENGSTROM. That problem will be the problem of the Bell System; the Bell Telephone System.

Mr. DOLLIVER. In bringing it in?

Dr. ENGSTROM. In bringing it in.

Mr. DOLLIVER. But, the transmitting equipment of the station in my home town will not require any changes in order to send a color signal out.

Dr. ENGSTROM. That is correct, except one monitoring set so that they can see the picture themselves.

Mr. DOLLIVER. Yes, of course; they will have to have that. They have to have that in black and white.

Dr. ENGSTROM. And, they will want it for color.

Mr. DOLLIVER. Surely. Well, that certainly would relieve them from a very substantial expenditure of funds, as compared with what they would have to spend if they had to reequip and redesign their whole transmission system.

Dr. ENGSTROM. That is correct.

Mr. DOLLIVER. So, they will be in a pretty good position in that respect.

Dr. ENGSTROM. Yes, sir.

Mr. DOLLIVER. Now, getting back to the question previously raised. I take it from what you say, in converting a black and white receiving set to one that would receive color, that you would have to do a lot more than simply replace the black and white tube with a color tube, would you not?

Dr. ENGSTROM. You would have to replace the tube, and you would have to rearrange and add the circuits.

Mr. DOLLIVER. In other words, it would take a considerably greater number of tubes, so to speak, in the set itself than already exists in such a set?

Dr. ENGSTROM. Yes, sir. There is another alternative. It has been referred to in the color hearings as a slave set; a second box, which would contain the color tube and circuits and then you would need the cable, in order to connect them. That may be done. I would not be surprised if some service organization might not set itself up to modify sets.

Mr. DOLLIVER. That is, you would have a color television and a black and white receiving set sitting side by side.

Dr. ENGSTROM. Yes, sir.

Mr. DOLLIVER. One other matter I had in mind. This proposal, of course, this thing we are going through or discussing right now may determine the future of color television broadcasting. At least I am

so convinced. And, whichever system comes into existence and is generally accepted, is going to be adopted, will dominate the field. Is that not true?

Dr. ENGSTROM. I believe that is what will happen.

Mr. DOLLIVER. It will be a good deal like the standard gage on the railroads.

Dr. ENGSTROM. That is true.

Mr. DOLLIVER. Whether you think that standard gage is right or not, there is no possibility of ever going back to a different gage for railroad tracks, and so whatever system comes into existence and receives general acceptation is going to be the prevailing system.

Dr. ENGSTROM. That is right.

Mr. DOLLIVER. Now, in the work of the color television committee to which you referred, are all of the possible systems being explored to determine which is the best and most practicable?

Dr. ENGSTROM. To the extent that we know them and can, yes, because we believe that in the signals we are proposing we have the best possible use of 6 megacycles that will be granted to us for a television station and that we have as broad a gage as we possibly can establish at the present time for its future growth.

Mr. DOLLIVER. Now, you said a moment ago, I think, that the standards which have been established for television broadcasting, which have been set up for black and white can also be accepted for color; is that correct?

Dr. ENGSTROM. They have been.

Mr. DOLLIVER. Maybe I did not use the right term.

Dr. ENGSTROM. The committee, the NTSC committee has used the black-and-white standards as a base ground for proceeding in color and the problem is how to put color in in addition.

Mr. DOLLIVER. So actually what you are doing is adding something to the existing system of television transmission.

Dr. ENGSTROM. Yes, sir; that is a correct expression.

Mr. DOLLIVER. Now finally you said something here about a revising of the television cameras to take color. At the present time I think you said you had three tubes.

Dr. ENGSTROM. Three tubes of the kind that are used in the black-and-white camera.

Mr. DOLLIVER. And each of those receive a separate color and they are mixed later?

Dr. ENGSTROM. Yes.

Mr. DOLLIVER. Now, what progress has been made along that line?

Dr. ENGSTROM. We have a tube that looks just like a black-and-white tube; a single tube, and we will have three terminals on it; one on red, one on green, and one on blue.

Mr. DOLLIVER. And that will substitute for the three tubes?

Dr. ENGSTROM. That will substitute for the three tubes, and is in the direction of simplification.

Mr. DOLLIVER. Is that camera in production at the present time?

Dr. ENGSTROM. No, sir. We are going to show it to you when you visit us in Princeton. It has been tested to the point that we know the principles are right and we are proceeding now to go through the engineering development of the camera.

Mr. DOLLIVER. One further question. I take it from your testimony here that the system which you have advocated, will be one which

will exclude the use of the system that has already been licensed with the Federal Communications Commission?

Dr. ENGSTROM. Well, sir, we are not asking that.

Mr. DOLLIVER. You are not asking that?

Dr. ENGSTROM. No, sir.

Mr. DOLLIVER. But your system if adopted will exclude it, because they are not compatible.

Dr. ENGSTROM. They are not compatible and if only one is taken I believe ours is the one.

Mr. DOLLIVER. In other words, your system would not, the signal which you send out, would not be accepted by the Columbia System.

Dr. ENGSTROM. You are talking about the receivers?

Mr. DOLLIVER. That is right.

Dr. ENGSTROM. Not unless that receiver were built to receive both color signals. That could be done.

Mr. DOLLIVER. You would have to have your kind of a tube there.

Dr. ENGSTROM. One would have to have an electronics tube to reproduce the picture in order to receive it.

Mr. DOLLIVER. In addition to the revolving disk?

Dr. ENGSTROM. Or in place of it.

Mr. DOLLIVER. I think that is all, Mr. Chairman.

Mr. WILLIAMS. Mr. Chairman.

The CHAIRMAN. Mr. Williams.

Mr. WILLIAMS. I have a question I would like to ask Dr. Engstrom in regard to the proposed changeover to color television.

Will this present any new problems in the maintenance of individual family sets? Are the present television repairmen equipped to repair color television sets, or would this changeover present any problems to these men in attempting to service those sets?

Dr. ENGSTROM. There will be newer circuits in the receivers, but they can be tested with the kind of equipment that the servicemen now have and any additional boxes, of course, that are provided for them. We do not see any reason why the servicemen cannot do it. As a matter of fact we have had our servicemen handling this in our field tests, and they have done well.

Mr. WILLIAMS. Then you think, as I get if from what you have said, that color television is sufficiently simple, or parallels the old system sufficiently, for the average repairman to move in and work on it without any special training or special courses in the subject of color?

Dr. ENGSTROM. I expect he will have some training. I suspect that will be done in instances in the factory. I suspect it will be done in schools for that purpose, because he will want to know how to do the work well and effectively. That happened with television when it first came in. But, we believe as a practical approach the serviceman can take it on and do the job and do it well.

Mr. WILLIAMS. You do not think that there will be a technical problem?

Dr. ENGSTROM. I do not.

Mr. SPRINGER. Mr. Chairman.

Mr. WILLIAMS. That is all. Thank you, sir.

Mr. SPRINGER. Mr. Chairman.

The CHAIRMAN. Mr. Springer.

Mr. SPRINGER. I would like to go over this subject for just a minute. How many hours are they broadcasting now, color television?

Dr. ENGSTROM. There are no hours of commercial broadcasting.

Mr. SPRINGER. They are experimenting before and after hours, are they not?

Dr. ENGSTROM. Yes, and as far as I know, as far as the compatible system is concerned——

Mr. SPRINGER. As far as what?

Dr. ENGSTROM. The compatible system is concerned.

Mr. SPRINGER. Are they not doing something in the before hours, in the early-morning hours?

Dr. ENGSTROM. I do not know, sir. You will have to ask them.

Mr. SPRINGER. Let me ask you this. How long will it take to build up the whole problem; the whole television system? It will depend on the number of sets that are available to receive it; will it not?

Dr. ENGSTROM. Yes, sir.

Mr. SPRINGER. There is no possibility of having color television then until you get color-television sets out in the community; is there?

Dr. ENGSTROM. You have to have receivers, color-television receivers; that is correct.

Mr. SPRINGER. Now, how long do you expect, or have you an opinion at this time, that it is going to take before you will have color television. In other words, if you had all of the color television available today that is needed to be sold to the public, how long would it take for the national system to be built up to a point where it would be profitable to broadcast color television?

Dr. ENGSTROM. With a compatible system, I do not see that it matters, or that it is serious at all.

Mr. SPRINGER. How long would it take?

Dr. ENGSTROM. Well, so far as we are concerned, tomorrow.

Mr. SPRINGER. So far as you are concerned tomorrow, but my point is when can NBC and CBS start broadcasting it?

Dr. ENGSTROM. We could start tomorrow if we had the authority. We have two studios now. To the extent that we could broadcast from those two studios, we could do it tomorrow. And from then on we would expand our facilities until we could gradually get into the balance, until we were actually broadcasting the same as black and white.

Mr. SPRINGER. You could begin broadcasting tomorrow?

Dr. ENGSTROM. Yes, sir.

Mr. SPRINGER. How much could you broadcast beginning tomorrow?

Dr. ENGSTROM. To the extent we could from the two studios we have, and I suspect two or three programs or four programs a week.

Mr. SPRINGER. Now, what would that cover? How many hours a week would be available, or would you be able to give?

Dr. ENGSTROM. Several hours.

Mr. SPRINGER. I mean, how many would you be able to reach, with reference to the public? How many people would that be available to?

Dr. ENGSTROM. Nobody in color.

Mr. SPRINGER. That is what I am talking about, in color.

Dr. ENGSTROM. There are no sets.

Mr. SPRINGER. That is what I say. If you take the sets that are in existence, and in the hands of the public, how long will it take to build up these programs to where they are going to be profitable to the CBS or the NBC to make these broadcasts?

Dr. ENGSTROM. I think we shall have to go at this in one or two ways. The growth of color television will take about the same rate as the chairman outlined for black and white.

Mr. SPRINGER. How long was that?

Dr. ENGSTROM. About 3 years before there were sufficient numbers of sets distributed through the United States. We are now 7 years from the beginning and we have 23,000,000 sets. So that it will go up, the same kind of a growth curve. It might be 100,000 the first year; it might be several hundred thousand the second, and then get into the millions.

Mr. SPRINGER. Now, you are going to have—the color-television sets are going to be the Cadillacs of TV. Is that not true?

Dr. ENGSTROM. Yes, for a while.

Mr. SPRINGER. Now, you are going to run into a resistance on that one factor, are you not, that is, as to your question of broadcasting, because the profit that can be made will depend on the number of sets out among the public. Is that not true?

Dr. ENGSTROM. No, sir.

Mr. SPRINGER. It is not?

Dr. ENGSTROM. No, sir.

Mr. SPRINGER. Will you explain why it is not?

Dr. ENGSTROM. Yes, sir; because if the National Broadcasting Co. could tomorrow broadcast one of its programs in color, and on the assumption that it was a network program, all of the sets that would normally be tuned to that program in black and white would still be tuned to it and on those sets they would get black and white.

Now, it is true that the sponsor might not be willing to pay more or enough to cover it.

Mr. SPRINGER. Is it going to cost any more to broadcast color?

Dr. ENGSTROM. A little more; yes.

Mr. SPRINGER. How much more?

Dr. ENGSTROM. We do not know exactly. They will have to have some more personnel for color. They will have to have more color background, they will have to have color consultants. So, I expect that that will add a certain percentage to the cost of the program, but we will have to remember that with black and white television, when we began, the broadcasters experimented and put their money into it. The sponsors experimented and put their money into it, and the same thing will be true of the color broadcasting.

Mr. SPRINGER. Right now these field tests you are conducting are being conducted in conjunction with the National Television Committee?

Dr. ENGSTROM. Yes.

Mr. SPRINGER. You are expecting to complete those tests by July or August, are you not?

Dr. ENGSTROM. Then or prior to that.

Mr. SPRINGER. Then or prior to that?

Dr. ENGSTROM. That is right.

Mr. SPRINGER. That is your belief at the present time?

Dr. ENGSTROM. Yes.

Mr. SPRINGER. Now, is the order of the Federal Communications Commission still in existence which creates these other standards?

Dr. ENGSTROM. Yes, sir.

Mr. SPRINGER. Now, if you were to broadcast over those standards you would receive, so your contention is, an inferior program, as a result of those standards?

Dr. ENGSTROM. In black and white?

Mr. SPRINGER. In color.

Dr. ENGSTROM. Yes, we do say so.

Mr. SPRINGER. I believe that is all.

Mr. DEROUNIAN. Mr. Chairman.

The CHAIRMAN. Mr. Derounian.

Mr. DEROUNIAN. What are some of the strategic materials covered by the NPA order back in 1951?

Dr. ENGSTROM. One of the things that was contemplated at the time was fractional horsepower motors to drive the discs.

Mr. DEROUNIAN. Now, was not copper used in the black-and-white sets too?

Dr. ENGSTROM. Surely.

Mr. DEROUNIAN. Now, how do you account for the fact that they made about eleven and a half million sets during 1951 and 1952, if strategic material was so vitally needed in national defense? It would seem to me that they did not take off the freeze, or if they did put on the freeze, they did not think it through very carefully. What I am getting at is this. I am just wondering whether or not this freeze that was put on may have been a double play between the FCC and the NPA, to stop the production of color television. Your whole statement seems to be an indictment of the FCC and I do hope that we will get these answers to the questions raised throughout this week, and I will withhold my judgment on the whole picture until we get the other story. Naturally you would be for RCA and you are playing on their team, which is quite natural.

My question then is, will your color set receive ordinary black-and-white signals?

Dr. ENGSTROM. Yes, sir.

Mr. DEROUNIAN. Without alteration?

Dr. ENGSTROM. Yes; without any change at all. In other words, we have a transmitter and a 1-hour program is color, and we have a color set, and a standard black-and-white set in the same location, so that we can receive both of them, when they are broadcasting color, we will get color on the color set and black-and-white on the black-and-white set. If at the end of an hour they are broadcasting black-and-white, the home owner will need to do nothing. The picture will be black and white on both receivers.

Mr. DEROUNIAN. That is all, Mr. Chairman.

The CHAIRMAN. Dr. Engstrom, we appreciate very much your presence here today and the very great help you have been to the committee in this matter in which they are so greatly interestd.

I think it would be pardonable if I suggest for a moment that there is a very great personal pleasure that comes to me individually to have reference to Camden, N. J., so frequently made during your presentation. I think all of the Members of Congress take pride in complimentary reference to their congressional district, but in my case I think I have a little more reason to be proud than in an ordinary case, because my mind goes back to the time in the city of Camden when I was a mere lad, a messenger boy in a law office. In the vicinity of the office there was a machine shop 20 by 40 feet. It was operated

by Eldridge Johnson, who afterward was president of the Victor Talking Machine Co., I remember they were experimenting on a talking machine in a building immediately adjoining us. I heard the scratch, scratch, scratch, day after day, hour after hour, for a long period of time before music was finally produced.

Afterward the small machine shop was taken down and the first building of the Victor Talking Machine Co. was constructed in the place of that machine shop. I have seen the business expand so that this first building became too small and was taken down and now we have the vast area covered by the different buildings of the RCA-Victor Co. in the city of Camden.

So, having seen that progress through the years, I think you will understand why I take pardonable pride in the reference that has been made to the important part that Camden is still taking in this great industry.

Dr. ENGSTROM. And we share that pride with you, sir.

The CHAIRMAN. Thank you, sir.

(Thereupon, at 12:37 p. m., the committee proceeded to the consideration of other business, after which it adjourned to meet at 10 a. m., the following morning, Wednesday, March 25, 1953.)

COLOR TELEVISION

WEDNESDAY, MARCH 25, 1953

HOUSE OF REPRESENTATIVES,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The committee met at 10 a. m., pursuant to adjournment, in room 1334, New House Office Building, Hon. Charles A. Wolverton (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

I notice in the audience our esteemed friend, Judge Evan Howell, United States Court of Claims, and if it is not incompatible with his work today on the court, of which he is such a distinguished member, we will be pleased to have him occupy the seat that he did so long in this committee.

Of course, you are on the right hand side now.

Judge HOWELL. Well, I do not believe, Mr. Chairman, there is anything incompatible with my work on the court in the hearing to be held today, and I appreciate the honor very much.

(Thereupon, Judge Howell took a seat as requested.)

STATEMENT OF DR. FRANK STANTON, PRESIDENT, COLUMBIA BROADCASTING SYSTEM, INC., NEW YORK, N. Y.

The CHAIRMAN. Our witness this morning is Dr. Frank Stanton, president of the Columbia Broadcasting System, Inc. Dr. Stanton went into broadcasting from the field of education in which he made a fine record. A native of Michigan, he was educated at Ohio Wesleyan and Ohio State University, later becoming a member of the faculty of the latter institution. Dr. Stanton holds several degrees from educational institutions, is the author of several books dealing with research, and has produced several films having to do with the same subject.

Upon joining the Columbia Broadcasting System in 1935, he served the organization in various capacities until he became president of CBS in 1946. The work of CBS in the field of color television was carried on under Dr. Stanton's immediate supervision and direction.

Dr. Stanton's broad interest in public education and information is attested to by his active participation in several organizations concerned with those objectives. He has been a director for several years of the Advertising Council, an organization devoted to the dissemination of public interest information. He has also just been appointed chairman of the board of one of the important advanced study projects sponsored by the Ford Foundation. Finally, he is at the present time a director of the National Citizens Committee for Public Schools.

Dr. Stanton, the committee is very happy to have you here this morning and to hear your views on the present status of color television.

Dr. Stanton.

Dr. STANTON. Mr. Chairman.

Mr. SCHENCK. Mr. Chairman.

The CHAIRMAN. Mr. Schenck.

Mr. SCHENCK. I would like, just before Dr. Stanton begins his testimony, to express my own personal appreciation that he is here as our witness today.

It has been my privilege to know Dr. Stanton ever since he was a young lad. It was my privilege and pleasure to teach high school both with and under his father's supervision, whom I knew for many, many years.

He has a most wonderful mother, who is a talented artist and, of course, Dr. Stanton's ability stems from the fine background of his parents' services.

He also has a younger brother who is an electronic engineer with the Monsanto Chemical Co.

So, I am especially happy that Dr. Stanton is here, because he is a distinguished representative from our home town, of Dayton, Ohio, and my district is better for having men like him in it.

Thank you.

The CHAIRMAN. We appreciate that.

Dr. STANTON. Thank you, Mr. Schenck.

The CHAIRMAN. We appreciate Mr. Schenck having those words in supplemental introduction. I take from what you have said that your brilliance has some relationship to your association with Dr. Stanton.

Mr. SCHENCK. Fortunately, reflected glory.

Dr. STANTON. Mr. Chairman, my name is Frank Stanton. I am President of the Columbia Broadcasting System, Inc., 485 Madison Avenue, New York City. I am appearing in response to a telegram dated March 14, 1953, from the chairman of this committee, requesting that I testify concerning the present status of color television.

I should like to state at the outset that I believe that the committee's decision to look into this question is healthy and beneficial. As CBS said in a year-end statement at the close of 1952.

> All elements in the industry and in the Government should strive promptly to resolve this question (of color television) so that all can go forward in vigorous efforts under whichever system prevails. It is devoutly to be hoped that this important issue be resolved as soon as possible in 1953 so that color broadcasting will once again be made available to provide the ultimate in education, entertainment, and information to viewers in their homes.

In undertaking this inquiry, this committee is making an important contribution toward achieving this objective of clarifying the question and speeding the day when this significant addition to the television art can be made available to the public.

I assume that this committee wants to know what the present situation in regard to color is, why color today is not further forward than it is, and, finally, what the portents are for the future. Although the story is rather long and complicated, I shall try to answer, for the Columbia Broadcasting System, these questions factually and as simply as possible. Some of this history which I will recount may be

well known to this committee, but I shall nevertheless set it forth so that you may have a complete and consecutive record.

PRESENT STATUS OF FIELD SEQUENTIAL SYSTEM

Let me start with the present and then trace in the earlier history which led to it. The present is simply this: Since June 25, 1951, there have been in effect official standards adopted by the Federal Communications Commission permitting any broadcaster to engage in regular commercial color television broadcasting under such standards. These standards are those which were developed and proposed by CPS in 1949; they provide for broadcasting of color television under what is known as the field sequential system. There is, however, no broadcasting under these color standards and, so far as I know, there is no manufacturing of receivers capable of receiving these standards.

Those are the stark and simple facts about the present status of the color television system adopted and authorized by the FCC.

The next question is how this situation came to be. I shall try briefly to recapitulate the history and the background.

CBS COLOR ACTIVITIES—1940–41

On August 27, 1940, CBS first broadcast field sequential color pictures over its then experimental New York television station. At the same time, CBS proposed to the industry committee which was then considering the standards which should be set for the inauguration of a black and white television service, that standards for color television also be adopted. In January 1941, an industry committee, then, as now, known as the National Television Systems Committee (NTSC), recommended to the FCC the present black and white 525-line standards and in addition recommended field tests of the CBS field sequential color system preparatory to early standardization. In making its recommendation, the NTCS emphasized "the potential importance of color to the television art." On May 3, 1941, the Commission issued its report adopting black and white television standards. In its report the Commission stated:

> The three-color television demonstrated by the Columbia Broadcasting System during the past few months has lifted television broadcasting into a new realm in entertainment possibilities. Color television has been known for years but additional research and development was necessary to bring it out of the laboratory for field tests. The three-color system demonstrated insures a place for some scheme of color transmissions in the development of television broadcasting.

In the report, the Commission requested the industry to undertake field tests of color television and to report back all data collected on or before January 1, 1942; it also requested "recommendations as to standards that may be adopted by the Commission for color television.

Thus in the spring of 1941—a dozen years ago—color television appeared to be imminent, its inception on a regular basis just a matter of months away.

But before the tests requested by the FCC and recommended by the NTCS had been completed, Pearl Harbor came and the war put an end to research and development in both black-and-white television and color television for the duration.

COLOR STATUS—1944–48

As World War II drew to its conclusion, consideration of the question of color television was revived. Mention was made of it, and preparations for it were discussed, in hearings before the FCC in 1944 and 1945. In June 1944, CBS recommended to the industry a wide-band field sequential system using the UHF; in October 1945, CBS began such color broadcasts on an experimental basis.

On September 27, 1946, before black-and-white television set production had been resumed on any but the most limited scale, and at a time when almost none of the then existing 10,000 sets were in the hands of the general public, CBS petitioned the FCC to adopt color standards embodying the wide-band field sequential system in the UHF. This, I might note, was the first time anyone had formally proposed the use of UHF for regular television broadcasting. On October 31, 1946, the Radio Corporation of America announced a "simultaneous" color television system which it termed "compatible" although existing black-and-white receivers could only receive black-and-white pictures from the "simultaneous" color transmissions by the addition to the set of a frequency converter costing about $75.

The FCC held hearings on the CBS petition between December 3, 1946 and February 13, 1947. In general, the industry, its committees, and the receiver manufacturers association testified adversely to the CBS proposal. Their position was that if the FCC would deny the CBS petition, they would be ready within 18 months (by September 1948) to recommend final color standards based on a "compatible" system.

One of the other major grounds of industry opposition was that the UHF was not capable of use for a regular broadcasting service, althought CBS presented pioneering extensive data showing the feasibility of UHF.

On March 18, 1947, the Commission denied the CBS petition for the adoption of color standards on the grounds that there had not been adequate field testing and that there might be other systems of transmitting color which would take up less spectrum space than the 12 to 14 megacycles which the proposed CBS system then required. The Commission called for further development and testing.

As a result of this decision, CBS color went back into our laboratories where work went forward to improve the system, particularly in the respects which the Commission had found it deficient. And in fact by 1948, CBS had found the way to confine color signals to the same spectrum width utilized by black and white television. In October 1948, CBS demonstrated to members of the FCC and its staff a 6-megacycle field sequential color system.

FCC COLOR HEARINGS AND DECISION, 1949–50

On July 11, 1949, the FCC on its own motion issued a notice calling for a hearing on color television and laying down certain criteria which any color-television system must meet to be considered for adoption. CBS came forward with its field sequential system; Color Television, Inc., proposed a compatible line-sequential system; and on August 25, 1949, RCA announced its compatible dot-sequential system.

Each of these three companies participated in the hearing as did a number of other companies, the receiver manufacturing association and various industry committees.

The hearings were before the full Commission and lasted from September 26, 1949, to May 26, 1950. There were almost 10,000 pages of testimony, 265 exhibits and a series of actual demonstrations, including side-by-side comparative demonstrations of the proposed systems. In general, the positions taken pro and con at these hearings were the same as those which had been taken in the 1946–47 hearings, except that this time there was no issue concerning UHF.

On September 1, 1950, the FCC issued its first report concerning the color-television issues. In the report, the FCC concluded that—

> color is an important improvement in television broadcasting. It adds both apparent definition and realism to pictures. It opens up whole new fields for effective broadcasting * * *.

The Commission made extensive and unanimous findings and conclusions evaluating the performance of each of the proposed systems. In essence, the Commission concluded that both the compatible systems—the CTI line-sequential system and the RCA dot-sequential system fell short of the minimum criteria which a color system must meet in order to be eligible for adoption. It concluded that the color fidelity and texture of the RCA color picture were not satisfactory, that the RCA receiving and transmitting equipment were too complex, and that the RCA system had not been sufficiently field tested. Concerning the CBS field-sequential system, the Commission concluded that the texture and color fidelity were most satisfactory and that receivers and station equipment were simple to handle. The Commission also found that the system had been adequately field tested. The Commission did not, however, for complex reasons which need not now be described, adopt standards for any color system at that time.

On October 10, 1950, the Commission, in a 5–2 decision, issued its second report. It stated that "We would be derelict in our responsibility to the public if we postponed a decision any longer." It concluded that it could not wait any longer for the development of the dot sequential or some other compatible system—that is, a system the color signals of which could produce black and white pictures on ordinary black-and-white receivers without any change in, or addition to, such receivers. While explicitly leaving the door open for future consideration of new systems as they might be developed, the Commission adopted color standards, effective November 20, 1950, for the CBC field-sequential system and thus authorized all broadcasters to begin a regular commercial-color television service.

It appeared, for the second time and after the lapse of 9 years, that the public would very shortly have color television.

INDUSTRY ACTIVITIES AND LITIGATION, 1950–51

Meanwhile, however, on October 4, 1950, a month after the Commission's first report, RCA had filed with the Commission a petition asking that the Commission delay its decision on color until after June 30, 1951. In its petition, RCA stated that subsequent to the closing of the hearings, it had made important improvements in its

dot sequential system; it requested the Commission to view these improvements between December 5, 1950, and January 5, 1951. It further stated that—

By June 30, 1951, we will show that the laboratory apparatus which RCA has heretofore demonstrated has been brought to fruition in a commercial, fully compatible, all-electronic, high-definition system of color television *available for immediate adoption of final standards.* [Italics my own.]

In a decision accompanying its second report, the Commission denied this RCA petition for delay.

Shortly after the Commission decision, CBS began large scale public demonstrations of color television in New York, Philadelphia, Boston, Chicago, Denver, New Orleans, and other cities. Hundreds of thousands of people attended these demonstrations.

On October 17, 1950, however, a month before the effective date of the new color standards, RCA brought suit in a Federal court in Chicago to enjoin taking effect of the new color standards. A number of other manufacturers joined with RCA in that suit. A temporary injunction was issued by the court while it considered the case.

Meanwhile, on October 22, 1950, in a broadcast over the CBS radio network, the president of the Radio-Television Manufacturers Association, stated that "many of the industry's leading engineers and scientists have been working on" a compatible color system and that they "are entirely confident" that such a system "can be developed in the relatively near future."

During December 1950, while the court in Chicago had the color case under consideration, RCA began its own demonstrations of its dot sequential system for the industry, the press and the public. Its spokesmen stated that these demonstrations established that all the objections which the FCC had raised in rejecting the RCA system had been overcome. He stated that—

RCA has now reached the point of development where it would normally start to put the system into mass production.

On December 22, 1950, the court in Chicago dismissed the RCA complaint, but it extended the temporary injunction until the Supreme Court had an opportunity to review the matter.

RCA and other plaintiffs then appealed to the United States Supreme Court. On May 28, 1951, the Supreme Court, without dissent and with only Mr. Justice Frankfurter issuing a "dubitante," affirmed the district court's decision and dissolved the injunction. Thereafter, the Commission designated June 25, 1951, as the effective date of the color standards —that is, the date on which regular commercial color broadcasting could begin.

INSTITUTION OF REGULAR COLOR BROADCASTING—CBS ACTIVITIES; INDUSTRY ATTITUDES

CBS immediately activated its plans to go forward under the new color system. On June 15, CBS acquired Hytron Radio & Electronics Co., an important manufacturer of television picture and vacuum tubes, together with Hytron's subsidiary, Air King (now known as CBS-Columbia), a manufacturer of radio and television sets. Until that time, CBS had never been in the television or radio manufacturing business. One of the major reasons for the acquisition

was to assure at least some source of supply for color television receivers.

On June 25, 1951, the date the color standards went into effect, CBS broadcast its first regular commercial color program. Completely sponsored by a number of advertisers, the program featured many of the major CBS stars. Thereafter, CBS rapidly began to expand its color program broadcasting schedule, and it furnished the programs on a network basis to other cities. During the first week, we carried 4½ hours of color programs, during the second week, 6 hours; by September 24, the schedule had increased to 7½ hours a week; and by the week of October 15, 1951, the schedule had increased to 12 hours a week of actual programing exclusive of test patterns. Plans were under way for further expansion of the broadcasting of color programs; additional programs were sponsored; our sales force was engaged in vigorous efforts to interest other advertisers and there were several promising prospects; and in order to increase broadcasting by stations not owned by CBS, we had completed plans to purchase and pay for time on some 10 affiliates along the eastern seaboard during which they would carry our color broadcasts.

On the manufacturing side, CBS-Columbia (Air King) also went forward. Preparation was completed for the manufacture of color receivers and by the middle of October the first color sets were reaching the retail stores and had been sold. A number of smaller companies had announced plans shortly to produce receivers, adapters, and converters and some of these had also reached the market. We were actively engaged in distributing the necessary engineering and design information to all potential sources of manufacture and we were doing our best to open up sources of supply and to encourage other units in the industry to go forward with manufacturing.

In general, however, the manufacturing industry as a whole remained inactive in respect of producing color equipment for the new system. A few of the larger manufacturers did give indications that they might proceed with the manufacture of color sets. But so far as we knew, most of the major manufacturers did not plan to engage in any significant production of equipment designed to receive the new color standards.

Instead, most of the manufacturing industry pursued the course of continuing the attempt to develop a compatible system.

Thus, on July 28, 1950, Dr. W. R. G. Baker, General Electric vice president and the present head of the NTSC, announced that GE had developed a new compatible system, called frequency interlace, and that the system could be demonstrated sometime after 90 days. I do not know what became of that system.

On May 28, 1951, the NTSC, which had been reestablished by the RTMA, announced a new compatible composite system which, it stated, combined the best elements of a number of previous proposals.

On June 18, 1951, just a week before the field sequential standards became effective, the NTSC announced the formation of a number of panels for the purpose of conducting field tests of the new compatible system.

During the week of July 10, 1951, just as the regular field sequential broadcasts were getting under way, RCA began a new series of widely publicized demonstrations of its compatible system for the press, the industry and the public. These demonstrations, together with special

NTSC demonstrations and field tests, continued through the summer and fall of 1951. In August 1951 the NTSC was reported to have stated that it hoped to have a compatible system ready for FCC consideration by the end of that year.

There the situation stood in the middle of October 1951. On the one hand, most of the industry, the receiver manufacturing association, and industry committees were demonstrating and publicizing a new version of the compatible system which they said was on the verge of completion and submission to the FCC. On the other hand, CBS and a few others were going forward vigorously under the standards which the FCC had adopted. Despite the publicity about the compatible system, I think that there was considerable momentum for the field sequential system. There were substantial indications that if we continued to press forward with our broadcasting and manufacturing efforts, sooner or later other manufacturers would begin to produce color equipment. We had real hope that the log jam would soon be broken. But at that time, most of the others in the industry were focusing their efforts on developing, demonstrating, and testing a new compatible system.

THE NPA ORDERS

On October 19, 1951, our momentum and our efforts came to an abrupt halt. On that date, Charles E. Wilson, Director of Defense Mobilization, addressed a letter to me stating that since the national emergency required the conservation of critical materials, it was necessary—

> to request industry to suspend plans for mass production of new products which are not absolutely essential . . .

Mr. Wilson concluded by stating:

> I am therefore requesting the Columbia Broadcasting System to suspend its plans for the manufacture of color television receivers in order to conserve critical materials until such time as these materials are in sufficient supply to warrant production. Your cooperation in this matter would be of great benefit to the defense effort.

I notified Mr. Wilson that CBS would immediately comply with the request. I also stated that we would suspend our regular schedule of color broadcasts in view of the fact that there would not be a sufficient number of color receivers in the hands of the public to warrant such a broadcast service. I stated that we looked forward to the day when we may resume our color production and make this electronic achievement available to the American people.

Mr. Wilson's letter of October 19 was followed shortly by a meeting with the manufacturing industry and on November 20, 1951, the National Production Authority issued NPA Order M–90 which expressly prohibited—

> manufacture of sets designed to receive color television, and items solely designed to permit or facilitate the reception of color television.

This order precluded any further regular color broadcasting or manufacturing.

We felt that the order was improper since it went beyond conservation of critical materials and instead controlled the end product for which such materials could be used, the only order of that nature which the NPS issued as far as we knew. But so far as CBS and

CBS-Columbia were concerned, the issue of the propriety and validity of M–90 was, and still remains, academic in its practical effect. Prior to Mr. Wilson's letter to us, we had sought to obtain additional allocations for CBS-Columbia, which, at the time we acquired it, was a relatively small company with limited allocations of materials. It was, therefore, necessary for us to obtain additional allocations if we were to embark upon a sufficient color production program to provide the necessary impetus for the industry. Even if all the materials permitted to CBS-Columbia at that time had been diverted completely to color production and we had abandoned black and white production—an economic course which we could not possibly follow since we had to continue to manufacture black and white—the materials still would have been insufficient to provide significent impetus to the color market. But NPA authorities concluded that materials were too scarce to permit us these necessary additional allocations.

Thus even without M–90, our inability to obtain additional allocations, because of the peculiar situation in which CBS-Columbia historically found itself, had the practical effect of making it impossible for us to go forward with color manufacture.

In any event, as a result of protest concerning M–90, on February 8, 1952, the NPA held a conference with the industry to consider amendment of the order. At this meeting, I took the position that while the issue was, as I have stated, academic so far as our manufacturing plans were concerned, the order was improper since it controlled the end product; I urged that it be amended so that any manufacturer be permitted to use his allocations either for color or black and white, as he chose. Some of the other industry representatives took the same position.

On June 24, 1952, the NPA issued a revised order M–90. This revision, however, provided no significant practical relief either for us or for other manufacturers who may have wished to go forward with manufacture of color equipment. While in form the amended order permitted the manufacture of home receiving sets, on application, it imposed such severe qualifications on manufacture that as a practical matter no one could proceed. Special permission for such manufacture had to be obtained and the applicant had to show that prior to June 24, 1951, he had made a substantial expenditure of funds in color research and development or in production or preparation for color manufacture. He further had to show that he would not increase his staff of electronic technicians, engineer design draftsmen, professional engineers, physicists, or tool-and-die makers, and in addition he was required to show that he would need no supplemental allotment of controlled materials.

In effect, therefore, even under the amendment, color set manufacture was, and is, for all practical purposes prohibited, for it was quite obvious that at least some additional personnel, as well as materials, would be needed. And by requiring that the manufacturer must have already spent substantial sums in research and development or in color production, in effect the order would have thrown much of the burden of going forward on CBS-Columbia by making it impossible for most other manufacturers—and particularly new companies—to make color sets even if they wished, since up to that date so much of the burden of research, development, and manufacturing preparation under the approved system had been borne by us.

So far as the approved field sequential system is concerned, that brings us to the present. We have continued our color work in the laboratories, concentrating largely on the application of the field sequential color system to closed circuit military, industrial, medical, and large screen theater television uses. We have worked on the further development of a tricolor tube. But there is now no manufacturing of home color receivers and no regular broadcasting, and there has been none since the middle of October 1951.

INDUSTRY ACTIVITIES; DEVELOPMENTS CONCERNING "COMPATIBLE" SYSTEMS—1952–53

As for public demonstrations of, and the publicly announced developments concerning, a new compatible system, there was also a considerable quiescence after the issuance of M–90. The public demonstrations of the compatible system halted in the fall of 1951 and have not been resumed. Field tests appear to have continued during 1952.

On March 4, 1952, Dr. Baker stated that field tests of a compatible system were expected to be completed "by late summer or early fall" of 1952, at which time the FCC would be petitioned to set standards for the NTSC compatible system. On April 21, 1952, Dr. Baker again stated that the NTSC hoped to complete fiield tests late in the summer of 1952.

Late in August 1952, Dr. Baker stated that the field tests of the compatible system might be completed early in 1953.

Early in February 1953, the NTSC released its revised field test specifications and standards for its compatible system. Dr. Baker stated that it "would take a minimum of 4 months to field test the new specifications." On February 26, 1953, Dr. Baker stated that "I think one can say that commercial color television is most certainly not imminent."

For precise details on the status of the NTSC system and its future, therefore, you will have to look to other witnesses who are more familiar with the plans of its proponents.

While, thus, I cannot speak on an informed basis either of the present status or the future of the new compatible system, I can speak with assurance concerning our own attitudes, policies and plans.

CBS PLANS CONCERNING FIELD SEQUENTIAL SYSTEM

First, I say reluctantly but realistically, that CBS has no plans, so long as the present circumstances exist, to broadcast or manufacture under the approved field sequential system.

A complex of factors compels this decision. There is, of course, the continued existence of NPA Order M–90. But even without that order and without restrictions on the availability of critical materials, I think that we would be tilting at windmills to undertake now, without any substantial industry support, to try to pick up again where we were forced to leave off in October 1951. We had thought, and we had hoped, that the FCC decision in 1950 and the long litigation would settle the matter at least for a reasonable time. We had thought, and we had hoped, that when during the FCC hearing, the president of RTMA testified that that association would support whatever sys-

tem the FCC decided to approve, there was some assurance of industry cooperation. We had thought, and we had hoped, that the FCC decision would bring an end to the conflicting claims (as the FCC black and white decision had done in 1941) and to the public confusion and bewilderment which resulted from such claims. We had thought, and we had hoped, that our broacasting and manufacturing efforts which cost us enormous energies and millions of dollars would supply enough impetus and competitive incentive for other broadcasters and other manufacturers to begin to follow our lead. As I have stated, there were some signs in the fall of 1951 that our hopes would be realized.

But that impetus has been lost and the field sequential system has been completely becalmed for a year and a half. Meanwhile, black-and-white-set sales have increased enormously. In 1940 when we first proposed color television and again in 1946 when we formally petitioned the Commission to approve color standards, there were no black and white sets in the hands of the general public and hence there was no problem of compatibility. In 1949, when the Commission undertook its own investigation of color and when we again came forward with our system, there were only 2 million black-and-white sets and the problem of compatibility was still relatively insignificant. But by the time the hearings and the litigation had ended in the spring of 1951 the problem of combatibility had been vastly magnified; there were over 12,500,000 sets in American homes. I cannot minimize the problems which this creates. I do not think that the problem of incompatibility is necessarily fatal. But I do think that the problem of incompatibility has now grown to such proportions that in combination with other factors, it becomes quixotic and economically foolish for us single handedly at this time to resume a large-scale broadcasting and manufacturing program under the field sequential system.

Chief of the other factors is the confusion engendered by what is represented, and has been ever since the close of the FCC hearings in the spring of 1950, at the imminence of a new combatible system. I think it would be wholly unrealistic for us to expect that no matter how vigorously or exhaustively we engaged in broadcasting or manufacturing under the field sequential system, any other manufacturer would make sets under that system or any substantial numbers of the public would buy such sets even if made, so long as there is the expectation that a new compatible system will momentarily be perfected and will be brought before the FCC.

We conclude that we would not be justified in undertaking at this time either to begin a regular color broadcast service under the existing color standards or to begin production of receivers.

CBS POSITION CONCERNING NTSC SYSTEM AND COMPATIBILITY

I cannot tell you what our position is on this new compatible system. I cannot tell you whether or not we shall support it, simply because we do not yet know enough about it, and hence we must reserve judgment. Producing a workable, practical, compatible system at a reasonable cost to the public is a challenging and difficult job. There are a host of unknowns and complexities. As Wayne Coy, the former Chairman of the FCC has stated, compatible systems have a habit of

appearing with great promise only to disappear into the limbo. The Commission in its decision concluded on the basis of the history of color development over the 10 previous years that the effort to make a system combatible has resulted in "either an unsatisfactory system from the standpoint of color picture quality, or a complex system, or both."

But doubts based on past experience are insufficient to warrant us in concluding now that this new system will not work. Perhaps this time it is different; perhaps this time they have found the answer. We do not know. On the basis of present but incomplete information, we believe that the new compatible system faces substantial problems, particularly in cost and complexity, both at the transmitting end and at the receiving end. We assume that the new system can under ideal conditions, closely supervised by laboratory technicians and engineers, produce a satisfactory color picture and a satisfactory black-and-white picture from color transmissions. But we do not know what happens in day-long week-in and week-out operations—whether for such a regular service the system is feasible and economical, either from the station point of view or the point of view of the receiver in the home.

But this much we do know with complete certainty: We are for any color system which works well, which is practical, and the cost of which is reasonable. We will support such a system, whether or not it is one developed by us or by a competitor or by somebody of whom we never even heard. As I said the very first time I testified at the hearings before the FCC in the fall of 1949 (transcript 2964)—

> We feel that color television is inevitable, and, therefore, the sooner the transition to it can be made the better for all concerned. Further, we feel that the dramatic nature of color will produce more effective programing and broader acceptance of television by the public, and that an affirmative decision on color will bring about stability in the industry.
>
> *As we have stated publicly, our fundamental position is this: We will support any color television system which best suits the problem, no matter by whom invented, no matter by whom suggested.* [Italics added.]

Further, I wish to repeat today, over 3 years later, what I said at both the beginning and end of my testimony before the FCC in 1949 hearings: We are in favor of compatibility. We believe it to be highly desirable both from the broadcasters' point of view and from the public's point of view. I reaffirm today what I said in the FCC hearings in 1950 (transcript 8643):

> If we could have compatibility in a system that works, Columbia would be there supporting it 100 percent. I would love it, and I want to make the record perfectly clear on that.

Let me assure this committee that we genuinely hope that this new system fulfills the promises made for it and that it is both compatible, practical, and economical. We are vigorously engaged in finding out all we can about this system. Our laboratories are proceeding with extensive tests and experiments so that we can come to an informed conclusion. And if this new system works, is practical, and its price is reasonable, we will support it with all our energies.

CBS LEADERSHIP IN COLOR TELEVISION

As the brief history which I have recounted for you establishes, CBS has been in the forefront of color from the beginning. I think

that, no matter whose color system ultimately prevails, our efforts will have played a large part in the fact that it is brought to the public at all. If nothing else, we have provided the stimulus which has speeded color along its way. We have fought for it and we have expended millions of dollars in the face of skepticism, indifference and active opposition. I take pride in a letter dated October 20, 1951, addressed to me by Senator Edwin C. Johnson, then chairman of the Senate Interstate and Foreign Commerce Committee, in which he said:

> I want to pay you a most deserved tribute for the courageous and unrelenting fight you have made on behalf of color television. Every conceivable road block was thrown across your path but you fought on and proved beyond dispute that a better television image is now ready for public enjoyment. Without your all-out endeavor, color television would have been 20 years away, just as many in the industry have hoped it might remain.
>
> Because of you, however, the greatest improvement in the art since it came into being is at hand here and now and ready to serve the moment conditions permit.
>
> I commend you as a patriot and a faithful sponsor of the people's interest for the great scientific contribution you have made to television.

CBS does not propose to abandon this leadership, which Senator Johnson so generously noted, in the struggle for color television. We still believe in color and we still believe that the public should have it at the earliest possible moment. We shall maintain our leadership in color irrespective of whether the system is our or somebody else's. Our interest and enthusiasm are for color television; they are not limited to our own color system as against another company's.

THE NEED FOR PROMPT DETERMINATION OF COLOR TELEVISION QUESTION

Finally, I wish to record our genuine hope that these hearings will speed the day of color by clearing the air and clarifying the confusion. It is to the interest of every segment of the industry as well as of the public to get this question settled at the earliest possible moment. Color television is peculiarly dynamic. No matter how many times it seems to be permanently buried, it raises its head once again. And every time color television revives, there is public confusion and industry dislocation.

We might as well face it; this will happen time and again until color television is finally a reality. All of us—broadcasters, manufacturers, distributors and dealers, and especially the public, which spends its dollars for receivers can plan sensibly and soundly for the future only if those who are interested in the new color system take the matter before the Commission, as we have repeatedly urged them to do since December 1950, and get this question settled once and for all at the earliest possible moment.

Once settled by the Commission—either in favor of the present field-sequential system or in favor of the new system—we can go forward to bring color television to the people promptly. I am confident that these hearings will contribute to that result, for which we so devoutly wish.

The CHAIRMAN. Dr. Stanton, the committee is appreciative of the very fine statement that you have made. I think you are to be commended for the frankness with which you have stated your position

and I am of the opinion that, from what you have said in the closing portion of your statement, that no matter whose color television ultimately prevails your efforts will have played a large part in the fact that it has brought to the public the encouragement and the stimulus which has sped color television along its way.

And while I can recognize you are pleased at the remarks that were made by Senator Johnson, yet I am not in a position to agree to all that he said, particularly "without your all-out endeavor, color television would have been 20 years away, just as many in the industry have hoped it might remain."

There has been no evidence before this committee as yet—whether there will be, I am unable to say—that will justify that statement. Maybe the Senator had some information that is not generally available to others. But certainly we do join with you in expressing our agreement that your company has had a leading part and a very important part in the progress that has been made in color television and we appreciate the importance of what you have said as to the necessity and the propriety for this question to be decided once and for all so that we can proceed in a way that will be of benefit to the public.

I am pleased that you have a feeling that these hearings will contribute to that reality. That is the purpose of these hearings.

Any questions, gentlemen?

Mr. O'HARA. Mr. Chairman.

The CHAIRMAN. Mr. O'Hara.

Mr. O'HARA. Dr. Stanton, I want to say to you that I want to compliment you on your statement. It is one of the most courageous statements I have ever listened to before this committee.

I can well appreciate the feelings and the hopes that the divergent groups had each for their own system, and the amount of money which has been spent in good faith by the divergent groups in experiments, and yet I realize that you have come in now at this point and make a statement that deserves a tribute from me and I want you to know that I honor you for having been so candid and forthright in your statement.

Dr. STANTON. Thank you.

Mr. O'HARA. Let me ask you this, Dr. Stanton: Do you think, in the light of what has happened, that the Federal Communications Commission made a mistake in adopting the Columbia system of color television?

Dr. STANTON. Congressman O'Hara, I think the FCC is probably in a better position to answer that than I am, of course. As a matter of fact, I had considered for a time including something on that in my statement, and if I can put my hands on that section, which I have not used, I might just read that because I think it might answer that question for you.

Mr. O'HARA. Dr. Stanton, I want you to answer it any way you care to.

Dr. STANTON. Well, I had given a lot of thought to the question, anticipating that such a question might be included or might properly have been included in my direct statement, and what I had intended incorporating, but did not put in, because it seemed to interrupt the flow of the history of this, was a statement which included the following.

I believe that if the facts are examined impartially and objectively both as they stood in the fall of 1950 and as the known facts stand today, the Commission's decision was entirely reasonable and in the public interest. I doubt whether there are many administrative decisions which could possibly have had the same exhaustive and painstaking consideration which the FCC's color decision had. No stone was unturned in ascertaining the facts, in hearing witnesses and in actually witnessing demonstrations of each of the proposed systems under all sorts of conditions. This was no hurried decision; in fact I can assure you that we were most exasperated at the time at what seemed to us to be the enormous number of days which the whole Commission spent on this matter.

The Commission had before it one system—the field-sequential system—which worked, which produced an excellent color picture in every variety of circumstance, which was practical and simple to operate from a broadcaster's point of view, and for which receivers could be made within easy reach of the purse of the public. On the other hand, the Commission had before it a system which had the advantage of being compatible but which had not yet been proven in and which in fact did not produce a satisfactory color picture and concerning which there were many grave questions.

The Commission therefore concluded, as it seems to me the facts required, that there was no assurance that the compatible system which was then presented to it for approval would ever be a practical, workable system. In fact, on the eve of the Commission's final decision in the fall of 1950, the proponents of that compatible system admitted in effect that the system was not ready because they urged the Commission to hold off a decision until the following spring when, they promised, it would be ready for commercial standardization.

The Commission was faced then with the choice of waiting for the fruition of a compatible system whose predecessors had previously failed. During this waiting period, the burden facing the field-sequential system would have been enormously aggravated as the incompatibility problem increased with each of the millions of new black-and-white receivers coming into the market. The Commission had a bird in the hand and it chose to keep it.

I do not believe that it is fair to conclude that what has happened since October 1950 has demonstrated the Commission to be wrong. For even now all the known facts available to us point to the conclusion that the field-sequential system is still the only practical, workable, relatively simple, and inexpensive system producing a good color picture—which after all is the only purpose of a color television system.

Surely the Commission could not have anticipated the Korean war or the NPA order. It could not, without being composed of incurable cynics and pessimists, have anticipated the continued misrepresentation concerning the field-sequential system and the resultant misunderstanding of the public. Nor could it have anticipated the persistent indifference and public criticism on the part of so many segments of the manufacturing industry—particularly in the light of the pledge of support which the RTMA president had given in the course of his testimony at the FCC hearings.

Indeed, it seems to me that subsequent events have proven the Commission was correct in its skepticism concerning the ultimate

success of the compatible system which had been brought before it in the 1949 and 1950 hearings. As I understand it, that system has undergone vast changes in its evolution to the latest compatible system for which the industry published tentative standards last month and which is now undergoing field tests. This present compatible system, our engineers tell me, is very different from the one proposed in 1949. Had the Commission adopted the compatible standards proposed in 1949 and had the public brought receivers under that compatible system, those receivers, I am told, would today be useless and would have to be completely remade in order to receive the signals under the new system proposed today. I do not believe that the Commission was supposed to have done its own inventing in order to anticipate what is virtually a wholly new system developed 2½ years later.

It is for these reasons that I think there is no substantial justification for the Monday morning quarterbacks, even 2½ years in this dynamic electronics field—and 2½ years of hindsight is a generation in any other field—to conclude that the Commission was wrong in its color decision.

Mr. O'HARA. Thank you, Dr. Stanton.

Mr. HINSHAW. Mr. Chairman.

The CHAIRMAN. Mr. Hinshaw.

Mr. HINSHAW. Dr. Stanton, I am a little bit confused from your testimony to know whether the field sequential system is dead or merely resting, for the time being.

Dr. STANTON. Did I understand you, sir; is it dead?

Mr. HINSHAW. Or resting.

Dr. STANTON. Well, I think it certainly is not dead. I suppose the only choice between those two is that it is resting. I think it has been arrested, if you will, by the events that have taken place since the Commission gave its blessing to the system in the fall of 1950.

I refer largely to the court action and to the delay that that caused, and the NPA order, of course.

Let me add, if I may, the fact that it is not resting in other places. It is only resting in the area of broadcasting to the public. The system is being used for military purposes; for medical, educational purposes; for other closed circuit uses, that is, not in broadcasting. So, it is by no means dead or resting in those regards, but only the broadcasting is resting.

Mr. HINSHAW. Is it impossible to find a tube in research that will make the field sequential system compatible?

Dr. STANTON. Well, it is not a question, sir, of a tube, or a receiver, because we have receivers and tubes. It is a question of the system in terms of this compatibility problem. There are tubes available, so that the system does not have to use the disk; it can take advantage of the all-electronic tube in the set and does not have to use the disk; but that is a matter of apparatus.

The system, though, the electronics part of the system, is not compatible in the sense that broadcasting color with the field-sequential system on the standards given down by the FCC could be received in black and white by existing black-and-white receivers—that is the compatible issue—and, by the delays that we have encountered from the time we first proposed the system until today, the problem of com-

patibility becomes almost insurmountable, but at the time we first proposed it there were virtually no black-and-white receivers in the hands of the public and even in 1949 when the FCC opened its hearings on color, that second round of hearings, even at that time there were I think around 2 million sets in the hands of the public; but today there are 23 million sets, and it is almost like the little boy—I think we said this at the time when we were going through these hearings—that we hoped that the Commission would hurry; while they had to examine all the evidence, we hoped that they would hurry, because we were afraid every day it was delayed, the position would be lost and the public would be denied the benefits from the field-sequential system, and I was going to say it was almost like the little boy who did away with his mother and his father, and when the judge was going to put him in an institution, he said: "You cannot do that, because I am a poor little orphan; but the delay which we had, not being taken care of, the situation here on the compatible factor—and that is a practical problem—the broadcasters suffer. It is not a question of whether there is an electronic tube.

Mr. HINSHAW. Is any modification necessary to be made to existing sets to receive the sequential system?

Dr. STANTON. In black and white?

Mr. HINSHAW. In black and white.

Dr. STANTON. Oh, yes. As a matter of fact, when we presented our case to the Commission in the fall of 1949 and the spring of 1950, in our demonstrations, we demonstrated three kinds of equipment, broadly.

First, a combination receiver, that could receive either black and white signals in black and white or the field-sequential signal in color.

Then we demonstrated an adapter which could be attached to existing black-and-white sets in the hands of the public so that they could receive field-sequential color in black and white.

We also demonstrated and proposed a converter which could be added to existing black-and-white sets, so that they could receive the field-sequential color signal in color.

So that we tried to cope with that in both directions.

Mr. HINSHAW. That is about what my memory of it is. I could not quite recall it exactly. You have refreshed by memory on that.

Now, from your statement I gathered that you are not a member of the NTSC.

Dr. STANTON. Our set manufacturing or receiver manufacturing subsidiary of CBS, Columbia, Inc., is a member of one of the panels, possibly two, I am not sure. But through that subsidiary we have membership in NTSC committee.

Mr. HINSHAW. That is all, Mr. Chairman.

Mr. PRIEST. Mr. Chairman.

The CHAIRMAN. Mr. Priest.

Mr. PRIEST. Dr. Stanton, I want to join my chairman and Mr. O'Hara in commending you for a very frank statement and a courageous statement and for the position that you have taken as stated on page 18:

> As we have stated publicly, our fundamental position is this: We will support any color television system which best suits the problem, no matter by whom invented, no matter by whom suggested.

I think that sort of a statement from the head of a great corporation such as yours is a very encouraging one to this committee and to the public.

I have just one question. I take it from your statement that you prefer, if a compatible system can be developed, that will give a good color picture at a reasonable cost to the broadcaster and to the public in the price of receiving sets, that you would prefer that to any other system; if those conditions could be met.

Dr. STANTON. If those conditions are met, sir, that is our position.

Mr. PRIEST. That is all for the present, Mr. Chairman. Again I want to thank you, Dr. Stanton, for what I consider to be one of the fairest presented statements that this committee has had on a controversial subject.

Dr. STANTON. Thank you, sir.

Mr. THORNBERRY. Mr. Chairman.

The CHAIRMAN. Mr. Thornberry.

Mr. THORNBERRY. Dr. Stanton, I would like to ask you a question. In the early part of your statement you referred to the field sequential system and also the dot sequential system. I believe this is the first time, so far as I am concerned, reference has been made to the dot sequential system. Is the dot sequential system the same as the compatible system?

Dr. STANTON. Well, sir, as to the dot sequential system, which was proposed, at the time it was represented that it was a compatible system.

Mr. THORNBERRY. The reason I ask that is I am a little confused. I had understood, in order to have an effective compatible system, that is, a system of broadcasting that could be received on present black and white sets, that it had to be by lines, rather than by dots. Am I confused on that?

Dr. STANTON. I think that we are both going to be confused, if I try to answer the question.

Mr. THORNBERRY. It would not be very difficult for you to confuse me on that.

Dr. STANTON. But, I think, sir, you might profit by asking that question of a witness who is better qualified in engineering. But, it is not necessary, as I understand the question of dots, or that it has to do with the compatible feature; and the dot sequential system which was proposed in the hearing that I referred to in my statement was a compatible system. The only difference was apparently it did not work well enough to make the FCC's approval, and the sets and the equipment that was required was complicated and expensive in addition.

We have always maintained, you see, that to have color and have it not in the Cadillac category, but have it in the small-car class, that that would be the answer, that it had to be in the price range that the public could afford, and that is why I have always insisted that the equipment not only work and give good color, but it be in a price range that you and I can afford to pay for it.

Mr. THORNBERRY. Now, if you take the two of us together and develop something that each of us can afford, generally, the public can well afford it. I will say that.

Now, Dr. Stanton, I want to add my appreciation to what the other members of the committee have said as to your frank presentation of your side of this question.

The thing that confuses me about it as a layman, not so well informed on this question and this controversy, is that the general public be kept in mind, and I think you have very well done that, as to the owners of these 23 million sets.

Now, if we are going to do a service to the public, we do not want to enter into something that will put the general public in a position where their present sets that they own are not equipped to receive the best that CBS or NBC, Dumont, or ABC puts out, but instead is going to cost a great deal more to obtain those, and I appreciate your viewpoint from that standpoint.

Dr. STANTON. Thank you.

Mr. DOLLIVER. Mr. Chairman.

The CHAIRMAN. Mr. Dolliver.

Mr. DOLLIVER. I want to joint the others, Dr. Stanton, in commending you for this fine statment.

There is one item of discussion between you and Mr. Hinshaw which I would like clarified a little further. Did I understand you to say that a tube had now been developed which would eliminate the necessity of the revolving color disks before the receiver in order to receive the field sequential system?

Dr. STANTON. That is absolutely correct. Several organizations in the industry have developed so-called all-electronic color tubes—Chromatic Laboratories; RCA; we have been working on one in our tube division, Tytron. There are others who have developed these tubes.

Mr. HINSHAW. Well now, would that development of a receiver tube for the field sequential system eliminate the necessity completely of a revolving disk?

Dr. STANTON. Oh, yes; absolutely.

Mr. HINSHAW. And remove the limitations as to the size of the picture which could be received over a field sequential system?

Dr. STANTON. Well, approximately. That latter question I think should be qualified; my answer to the latter question should be qualified a little bit in the sense that I have not as yet seen a 27-inch or a 30-inch all-electronic color tube. I have no doubt that they are within the realm of manufacturing facilities and know-how.

The color tubes that I have seen have been more of the order of the 20-inch variety; but you are certainly correct in the understanding that you have that the existence of these tubes——

Mr. HINSHAW. Now, it seems to me that is a very important thing, because perhaps this follows and perhaps does not. I am seeking information. Does it follow from that, that a set might possibly be developed or a tube might possibly be developed which would be receptive of the dot sequential system, or the full compatible system that was advocated yesterday, and also receptive of the field sequential system which is the system which has been approved by the FCC and also would receive a black and white transmittal of television?

Dr. STANTON. Yes. To begin with I am giving you an answer of a nonengineering witness, and, of course, it is easier for a nonengineer to say what the engineers can do than perhaps for the engineers to say. But, I would have no hesitation in saying that such a tube could be developed. I think it would be impractical from the public's point of view and from the broadcasters' point of view, for the following reasons.

First, I think it would be an enormous piece of equipment, because of the circuitry that would be required to accomplish the objectives that you outline. I think it would be too costly to get anything like a large number of such units in the hands of the public.

Third, it seems to me that the broadcasters would have to make a decision as to whether he was going to broadcast black and white, or whether he was going to broadcast the field sequential color, or whether he was going to broadcast the dot sequential color.

Now, that means a rather elaborate capital expenditure and investment in studio equipment and cameras, and so forth for station operators. Television is expensive enough without adding that extra burden, if you will, to the broadcasters or to the public.

But, to come back to your question. You are absolutely right, in my opinion, that such a unit could be built.

Mr. HINSHAW. From the practical standpoint, what you are telling us then is that the industry, incidentally, the public and the FCC, is going to have to make a choice as to whether they are going to follow through with the field sequential system already approved, or produce a dot system, a compatible system, which was urged upon us yesterday.

Dr. STANTON. Yes, sir. At the time the color hearings took place in 1949 or 1950, this question you are raising was raised by one of the members of the FCC, and I think I said as plainly as I could possibly say it at that time, that I thought that the Commission, representing the public and the interest of the public involved in this thing, had to make a choice that could not be put up to the public, because that was too expensive a bill for the public to pay and too expensive a bill for the broadcasters to pay. I did not want to see that saddled on the backs of the public or the broadcasters, and I think that is the feeling of the FCC in this particular case, on the evidence, and representing the public interest, by making a choice of the system that they think is the best system for everybody concerned.

Mr. HINSHAW. May I say, Dr. Stanton, that I agree with the conclusions you arrived at that the decision, the licensing of the field sequential system was a proper and appropriate one at the time it was made.

I think the Communications Commission probably could not have done other than they did do; but I also agree with you, as you so clearly outline in our statement, that the situation has now changed, to a degree where the Commission and the public and the industry generally must consider the necessity of securing a full compatible system before embarking on color television broadcasting. That is all, Mr. Chairman.

Mr. ROGERS. Mr. Chairman.

The CHAIRMAN. Mr. Rogers.

Mr. ROGERS. I want to preface my remarks by joining the chairman and my other colleagues in what they have said about your statement and I especially want to commend you on the cooperative spirit. In other words, you appear to be rendering a public service, and you want the system which is best.

I want to ask you one or two questions.

Now, you said that there were some 23,000,000 TV sets in the public's hands now?

Dr. STANTON. Yes.

Mr. ROGERS. And today a device can be used on these present television sets to take advantage of the color system. Is that correct?

Dr. STANTON. That is correct.

Mr. ROGERS. Now, about what would be the approximate cost of a device or whatever you want to call it, that would make it possible to use our present sets to get the advantages of color television?

Dr. STANTON. Well, sir, if you will let me refer to some notes I have here—I would like to be sure that I have the right figures, when I give you an answer to that question.

Reading, Mr. Chairman, from the testimony that was put in evidence at the time of the hearings, the cost of a converter for the field sequential system which was submitted at the time of the 1949–1950 hearings, the cost, retail costs were given as $70 to $55 exclusive of installation. Those were the two witnesses.

Another witness' estimate, as I recall, was that it would cost $75 to $80. It was estimated at the time that the toal conversion cost, including adaptation of existing sets and installation costs, would be $95 to $115.

Now, I should say there are two ways of going about this problem and there are two things needed.

First, in order to get, in order to receive a clear signal in black and white on existing sets, you have to go through the process of modifying your existing sets, with an adapter. If you want to carry that one step further, so that you get clear signals on existing sets, then we have used the nomenclature of converter and a converter is needed. Now, that last figure I gave you of $95 to $105 included the adapter and the converter.

If you go just to the adapter, which is just to receive the clear picture in black and white, those estimates run from $32 to $48 on the part of one witness and $34.95, to $39.95 by another.

Then in addition there is the third way to achieve this thing and that is sets could be sold to the public, that is black and white receivers, which would have what we call internal adapters. In other words, when the sets are built at the time they are in progress of production provision could be made for the circuitry, so that it could receive color and black and white.

I believe at the time of the color hearings before the FCC that RCA estimated that that could be done by an internal adaptation. In other words, at the time the set was built at the factory, it could be done for around $10.

Mr. ROGERS. Now, the estimates that you make there, do they include installations, or just the instrument itself?

Dr. STANTON. The first figure I gave, of $105 to $115, included installation costs.

Mr. ROGERS. Now, Doctor, what is your opinion, if you had not been impeded in installing this color system, how far would you have gotten; what progress would have been made up to the present time?

Dr. STANTON. Well, that is a difficult one to answer, sir.

At the time NPA order came down and we were stopped dead in our tracks, I was very optimistic that we were just on the threshhold of color television as far as the field sequential system was concerned.

I think that by the spring of 1952 we would have been making a great deal of progress in terms of getting sets into the hands of the

public and a schedule of color broadcasting on the networks. This nipped it right in the bud, so to speak, this NPA order, and, of course, the delay from the fall of 1951 until the spring—from the fall of 1950, to the spring of 1951, came about as a result of litigation. That was very costly in terms of delay, because of the increased sets that were sold; but I cannot give a quantitative answer to it, and I am sure that others in the industry would take issue with me on my answer to your question; but as far as I could see it, I was optimistic and we were going full steam ahead. We were tooling up as rapidly as possible for the manufacture, for the mass production, rather, of color receivers and we were equipping studios and expanding our program series. We had just embarked upon a very elaborate series of important broadcasts; broadcasting the best plays, which we were going to do in color. We had even announced that just prior to the NPA order the character of the plays and the stars that were going to be performing in those plays, and I think it was such that it would have forced its way into many, many places in this country. It was a very substantial program.

Mr. ROGERS. It is your thought that any outside influence was brought to bear on NPA to bring about that order—M–90.

Dr. STANTON. I know of no such outside influence, sir.

Mr. ROGERS. That is all, Mr. Chairman.

Mr. HESELTON. Mr. Chairman.

The CHAIRMAN. Mr. Heselton.

Mr. HESELTON. I want to ask you some questions, not only on your direct testimony this morning, but upon your answers to questions by my colleagues. May I say that I join them in commending you for the excellent statement you have given us.

Are you aware of the statement made by Dr. Engstrom to this committee yesterday?

Dr. STANTON. I read his direct statement; yes, sir.

Mr. HESELTON. Are you in a position to say whether CBS would join in the recommendations that the Commission should, without any necessity of prolonged hearings, settle this matter now—and I have in mind your very forthrtight position when you stated that it is the function and the responsibility of the Commission to represent the best interests of the public.

Dr. STANTON. Well, first of all, I think that I would want to know more about the system that is being proposed, before I could join hands with RCA, so to speak, on the program that they have recommended of the Commission's action without a hearing. But, even on the latter point, I was considerably confused by the witness' testimony because it seemed to me that at one point he was recommending that sometime within 6 months they would petition the Commission and at another point suggesting that the Commission could take this action without a hearing.

I do not know anything about the legal problems involved, but from a practical point of view, I was confused by what seemed to me to be an inconsistency in the statement itself regarding the 6-months' petition and the Commission's independent action; but underlying that whole thing, before CBS, before I recommend to our organization that we go along on this, I would just have to know more than I know today about the factors that we think are so vital to the success of the color television system.

Mr. HESELTON. I had in mind the portion of your statement in which you said you felt that these hearings before this committee were making a very real contribution toward the ultimate settlement of this controversy and it would seem to me that one of the real possibilities would be that RCA and CBS, and anybody else involved in this might join hands in urging upon the Commission as speedy action as possible. You have already indicated your desire for speedy action and the public is entitled to prompt action.

Dr. STANTON. I think that the Commission will act promptly if it gets, or when anyone applies for consideration. In the order that came out at that time, when the field sequential system was established, the Commission as you probably know outlined and set forth the procedure for coming back in for consideration of other systems. They left the door open as they so often do, and I think the Commission would be responsive to the petition to give prompt consideration of a new system.

I think it is very important from another point of view and that is that I think that the manufacturers of television equipment, and I think the distributors and the retailers are going to feel the impact of this discussion here before this body, because I think it is going to raise once again in the minds of the public the question of whether it should go out and put down $300 or $400 or $500 for a set that might be obsolete in a very short time, and I think you are in a very sensitive position on that score, because I think the more effective these hearings become, the more the manufacturers and the retaliers are going to be on the telephone or in the mail or in person, to ask for a speedy determination of this question.

Mr. HESELTON. Are you in a position to venture any statement as to how long you think it is going to take before the public has a decision from the Commission; the final decision?

Dr. STANTON. I think that the best I could do with that would be to give a range of time and I do not think it is a very good answer; but allowing for the notice periods, and all of the machinery that has to be gone into for such a hearing, I suppose it would be anything from 6 months to a year and 6 months, and, then, of course, on top of that, from a practical point of view, you would have to add the time it takes for the industry to tool up and be ready to produce and put sets in the hands of the public.

Mr. HESELTON. I am not asking this because of any preconcieived idea that there is anything irregular or improper, but have you any knowledge as to the curent rate of production of receiving sets, black-and-white receiving sets?

Dr. STANTON. Well, as I recall the January and February 1953 production totals ran about 1,463,000 units. That is the highest January and February in the history of the set manufacturing business and as I recall, up to the present time, largely I think because another half of the country has been opened up by virtue of the thaw. Set production, black and white, is probably at an all time high.

Mr. HESELTON. And that very factor is another reason for pressure on the Commission to get this thing settled?

Dr. STANTON. There is no question about that. That is the thing that I was referring to, and referring to the producers and the distributors and the retailers. I think they are going to be hurt by this talk about color, because it is coming at this time of the year, when

the set manufacturing sales normally take a seasonable dip, and this will have a very marked effect upon it.

Mr. HESELTON. Thank you very much.

Mr. HARRIS. Mr. Chairman.

The CHAIRMAN. Mr. Harris.

Mr. HARRIS. Dr. Stanton, I want to say that I too appreciate the very frank statement you have made about the entire problem.

Are you in a position to explain to us very briefly what the field sequential system is, and compare the line sequential system and the compatible dot sequential system?

Dr. STANTON. I am pausing, sir, only because I do not know whether I can measure up to that one or not. It is a pretty complicated question or, the answer is rather complicated, and——

Mr. HARRIS. We could ask a technical witness, if you prefer.

Dr. STANTON. I think that maybe you might get a better answer.

The CHAIRMAN. If there is anyone in the room that you would like to consult before answering it, you may do so.

Dr. STANTON. I am afraid you will have to adjourn, sir, before I could get the answer in form to give it to you.

Mr. HARRIS. Could you supply the answer for the record in the form you would like to have it?

Dr. STANTON. Surely. I will be glad to do that.

Mr. HARRIS. Will that be acceptable, Mr. Chairman?

The CHAIRMAN. It is.

Mr. HARRIS. Yes.

Dr. STANTON. I shall be glad to do that.

(The information requested follows:)

EXHIBIT A

[From the first report of the Commission (on color television) adopted and released on September 1, 1950]

THE CTI SYSTEM

36. It is difficult to make an adequate description of the CTI system because it was frequently changed during the course of the hearing, technical witnesses for CTI were not in complete agreement, and some of the more complicated points were never clearly expounded by CTI. We have, however, endeavored to make as complete and accurate a description as possible.

37. As has already been indicated, the CTI system is a line sequential system. In this system, scanning is at the same rate as in the monochrome system—15,750 lines and 60 fields per second. The system derives its name from the fact that as the scanning of each line is completed, the color is changed. Thus, line 1 is scanned in red, line 3 in green, line 5 in blue, line 7 in red, and so on to the bottom of the picture. This completes a field and the scanning beam snaps back to the top of the picture where the even lines are then scanned in the same fashion. Thus, at the end of the second field, all of the lines have been scanned once, but each line will have been scanned in but one color. In order for each line to be scanned in each color, it is necessary to change the initiation of the color scanning between fields. Otherwise, in field 3, line 1 would be scanned in red again, line 3 in green, line 5 in blue, and so on. It is thus necessary to provide, for example, that in field 3, line 1 be scanned in green and in field 5, in blue. This change in the initiation of the color scanning insures that each line is scanned in each of the three primary colors. As a result, it takes six complete fields within which all lines are scanned in all colors. Thus, in this particular system, 10 color pictures are completed each second.

38. If a uniform change in the initiation of color scanning—such as is described in the preceding paragraph—were utilized, a serious line crawl would be apparent across the image. Several sequences of nonuniform shifts were demonstrated by CTI in an effort to minimize line crawl. One of the earlier shifts was called the single shift and resulted in scanning each picture line in only two of the three

primary colors. This shift was abandoned by CTI in favor of a double shift. Several variants of the double shift were described by CTI witnesses. The most recent form of double shift and the one presently urged by CTI was demonstrated in San Francisco on May 17, 1950. It is called the interlaced shift. In this system, the order of scanning is changed from the normal pattern where odd lines are first scanned and then even lines, so that the odd lines are scanned in three successive fields, then the even lines are scanned in three successive fields, and so on. The color sequence scanning is so arranged that adjacent lines are not scanned in the same color in successive fields and the progression of color from line to line is revised at intervals not in excess of three succeeding fields. Ten complete color pictures per second result from the interlaced shift. An additional synchronizing pulse is required during the vertical blanking period for the operation of the color shift.

39. The apparatus with which CTI demonstrated its system may be briefly described as follows: At the transmitting end there is a single camera tube, upon the surface of which the optical system projects three primary color images of the scene, side by side—red, green, and blue. The electron beam starts scanning at the left which is in the red area. This portion of the tube responds only to red components and as the electron beam scans through this red portion, it generates signals which vary in amplitude in proportion with the relative intensity of the red components. It takes 1/15750 of a second to complete line 1—the time required under our present standards for the scanning of one line. At the expiration of this time, the scanning beam enters the green area and since the electron beam scans at a sloping angle, the beam is now at line 3. This line is scanned in green in 1/15750 of a second. The scanning beam then enters the blue area at line 5 and scans this in blue in 1/15750 of a second. The electron beam then snaps back to the left-hand side of the picture to scan line 7 in red, and so on until one field is completed in 1/60 of a second. The process is then repeated for successive fields. At the receiver, a similar scanning process is employed in connection with a cathode-ray tube having three vertical bands of color primary phosphors—red, green, and blue. A suitable optical system is employed to superimpose the three color images on a viewing screen.

40. All of the synchronizing signals, horizontal and vertical, employed in the case of monochrome are also utilized in the CTI system; there are also additional synchronizing signals discussed above. The CTI color receiver must be so constructed that it does not react to each horizontal synchronizing pulse in the same manner as a monochrome receiver. If it did, the scanning beam would be snapped back to the left hand of the picture when the first pulse is transmitted—at 1/15750 of a second. However, at that moment the scanning beam has only traversed the first third of the tube's surface—the red portion—and must still scan across the green and blue surface. Accordingly, appropriate circuits are required to make sure that the scanning beam is snapped back only after every third horizontal pulse. This can be accomplished by appropriate counting circuits or by adding an appropriate pulse during the blanking period of each third horizontal pulse.

THE CBS SYSTEM

41. In the CBS system scanning is accomplished in the same manner as in the present system. First, all of the odd lines are scanned and then the even lines, and so on. The effect of color is achieved by the fact that when the odd lines are scanned in the first field, they are scanned in red; the even lines of the second field are scanned in blue; the odd lines of the third field are scanned in green; the even lines of the fourth field are scanned in red; the odd line of the fifth field are scanned in blue; and the even lines of the sixth field are scanned in green. Thus, it takes six complete fields to produce one complete color picture. The fact that the color is switched at the end of each field gives the CBS system its name, field sequential system.

42. The CBS system does not utilize the same scanning standards as does monochrome television. Instead of 525 lines the CBS system has 405 lines. The theoretical horizontal resolution in terms of lines is reduced from 380 lines to 205. A field rate of 144 per seconod is employed instead of 60, and 24 complete pictures per second result rather than 30. Under the CBS system the horizontal synchronizing rate is 29,160 per second[1] as compared with 15,750 per second for

[1] This figure is derived as follows: Each complete picture per second has 405 lines. Each of the 24 complete color pictures is composed of three 405 line pictures made up of red, blue, and green components. Thus, 405 x 24 x 3 = 29,160.

black and white, and the vertical synchronizing rate is 144 per second as contrasted with 60 per second for black and white.

43. During the latter stages of the hearing, CBS offered testimony concerning the utilization of horizontal interlace in its system as a means of improving horizontal detail; it did not offer horizontal interlace as a proposal. A demonstration of this process was held on the record in New York City on April 26, 1950. In this system, each line is broken up into picture elements with blank spaces in between. In the first field, alternate dots are sampled for the odd lines in field two, alternate dots are sampled [2] for the even lines. The blank spaces are filled in by successive fields. It thus takes 12 fields to produce a complete color picture and as a result 12 complete color pictures per second occur. However, even with horizontal interlace, color switching in the CBS system occurs after each field, the horizontal interlace being used to increase the horizontal resolution.

44. The apparatus utilized by CBS to demonstrate its system can be described as follows: At the camera a rotating disc containing segments of red, blue and green filters is inserted between the lens and the tube. The disk rotation is coordinated with the field scanning rate of 144 per second. In the 1/144 of a second that the red filter is in front of the tube, all of the odd lines are scanned. Since the filter transmits red components, the scanning beam generates signals that vary in amplitude in proportion to the varying intensity of the red components of the scene being transmitted. The same process is repeated for each field. At the receiver a rotating disc with colored segments is placed in front of the cathode-ray tube. When the receicer is turned on and the motor attains its full speed, the color disc may or may not be in proper step with the disc at the camera. If the colors are false, as indicated by skin tones or other obvious color faults, the viewer presses a button to place the disc in step. This may require one or two pushes of the button. Once the correct color position is attained, the synchronizing pulses automatically keep it correct. The scanning at the receiver repeats the process at the camera end, and a color picture results. At the New York demonstration, CBS also demonstrated a projection receiver somewhat similar to that employed by CTI. In addition, at the Laurel demonstration, it demonstrated a receiver which automatically chose the correct color. This requires an extra synchronizing signal to insure correct color phase.

D. THE RCA SYSTEM

45. It is difficult to make an accurate description of the RCA system because it involves new and complex techniques, many of which were never clearly expounded during the hearing. We have, however, endeavored to make as complete and accurate a description as possible.

45. It is difficult to make an accurate description of the RCA system because it scanning method utilized under the present system. As will be recalled, under the present system the electron beam scans a line continuously from left to right, skips a line, scans another line, and so forth until the end of the field. The lines that were not scanned during the first field are then scanned in the second field. This is line interlace and the process is retained in the RCA system. What RCA has done is to add a process called dot interlace. As the name implies, dot interlace is accomplished by scanning each line in a series of dots rather than continuously. As illustrated in the table below, during the first scanning field, the odd numbered lines are scanned in order. Colored dots are laid down in order along line 1 as shown. Next, line 3 is scanned with a displacement for each color dot shown. The remaining odd lines are scanned in order. This scanning of the first field takes place in one-sixtieth of a second.

47. During the second field, the even lines are scanned, first line 2 with the colors laid down as shown, then line 4, and so on. The dot pattern laid down during the third field is shown by the lower diagram where the odd lines are scanned in succession. During the fourth field, the even lines are again scanned in succession with the color dot pattern shown. Thus, the odd lines are scanned during the first field, but dots of the same primary color are separated by spaces. The even lines are scanned during the second field, again with spaces between like color dots. During the third field, the odd lines are again scanned but with the color dots displaced so that the spaces are filled. The even lines are scanned during the fourth field, with the color dots displaced to fill in the spaces left dur-

[2] A description of sampling is set forth in Paragraph 51 in connection with the RCA system.

ing the second field scanning. Four scanning fields are required to completely cover the picture area, with all spaces filled, with say, green dots. Simultaneously, the area is being covered with red dots and with blue dots. Since there are 60 fields per second, it may be said that there are 15 complete color pictures per second.

1ST FIELD

Line							
1	G	R	B	G	R	B	
2							
3		B	G	R	B	G	R
4							
5	G	R	B	G	R	B	
6							

2D FIELD

Line							
1							
2		B	G	R	B	G	R
3							
4	G	R	B	G	R	B	
5							
6		B	G	R	B	G	R

3D FIELD

Line							
1		B	G	R	B	G	R
2							
3	G	R	B	G	R	B	
4							
5		B	G	R	B	G	R
6							

4TH FIELD

Line							
1							
2	G	R	B	G	R	B	
3							
4		B	G	R	B	G	R
5							
6	G	R	B	G	R	B	

Combining the above lines, dots and fields into one table, we have the following representation of a complete color picture (the numbers in the table refer to fields):

Line	G	B	R	G	B	R	G	B	R	G	B	R
1	1	3	1	3	1	3	1	3	1	3	1	3
2	4	2	4	2	4	2	4	2	4	2	4	2
3	3	1	3	1	3	1	3	1	3	1	3	1
4	2	4	2	4	2	4	2	4	2	4	2	4
5	1	3	1	3	1	3	1	3	1	3	1	3
6	4	2	4	2	4	2	4	2	4	2	4	2

48. Scanning is accomplished in the following manner. The RCA color camera consists of three separate camera tubes, each of which is capable of response to 4 megacycles. In front of these tubes is an optical system consisting of dichroic-mirrors and lens. The dichroic mirrors are so constructed that each one reflects only one of the three primary colors—green, blue, red. The light reflected by each such mirror falls upon the photosensitive surface of one of the three camera tubes. Each of the camera tubes has applied to it the same horizontal and vertical scanning pulses from a common synchronizing generator. The electron scanning beams in the three tubes thus scan the entire scene simultaneously and generate separate signals. Of course, the signals generated by the scanning beam in the green tube vary in amplitude in proportion to the relative intensity of the green components of the picture being scanned and similarly for the blue and red cameras.

49. Thus, three signals are derived from the camera tubes, each with a response out to four megacycles. Since these signals must be transmitted in a 4-megacycle video band, some method must be devised of combining or merging these signals for purposes of transmission. To understand how this is done, a discussion of the so-called mixed-highs principle is necessary.

50. As was set forth above, each of the three camera tubes in the RCA system is capable of response out to four megacycles. Where a picture being scanned does not have fine detail, the full response of 4 megacycles is not necessary. Coarse detail can be transmitted by a camera with a much narower response—e. g., 2 megacycles. The response between 2 and 4 megacycles is necessary for fine detail. During the hearings RCA presented evidence designed to show that the human eye is not at all sensitive to fine detail in color; that the physiology of the eye is such that it can distinguish colors only in coarse detail; for example, the eye can recognize color in a piece of colored string but cannot in the case of a single strand of colored thread held at any appreciable distance from the observer. RCA testified that it devised a system whereby the coarse detail of the picture (e. g. from 0–2 megacycles) is transmitted in color whereas the fine detail in each of the colors (e. g. from 2–4 megacycles) are "mixed" together and transmitted as black and white pictures. The two signals are then transmitted together and give a color picture composed of the low fre-

quency components (0–2 megacycles) for each of the three primary colors and the mixed highs (2–4 megacycles) as black and white.

51. It is claimed that the above process has saved band width. Instead of 12 megacycles being required to transmit three 4-megacycle signals, the requirement is reduced to eight megacycles—2 megacycles for each of the 3 low frequency color signals and 2 megacycles for the mixed highs. Of course, even 8 megacycles are too much for the 4-megacycle band available. RCA endeavors to save the rest of the space by a process known as dot interlace which involves color sampling. Part of the band saving comes from the fact that it requires four fields instead of two in order to completely scan the picture area once as illustrated in paragraphs 46 and 47. The rest of the apparent band saving comes from permitting a certain amount of cross talk (dilution of color and contrast) in the picture. Each of the 3 signals passes through appropriate electrical filters. These filters separate the low frequency components (0–2 megacycles) out of each of the three color signals. The low frequency color signals are sent to an electronic commutator or sampler. The remaining high frequency components are combined into mixed highs. The sampler operates as an automatic high speed valve that opens and closes at a rate of approximately 11 million times per second. The three color signals enter the sampler. The sampler is so arranged that each 3.6 millionth of a second the sampler opens the valve to the green, red and blue signals in sequence and permits that portion of the particular color signal to pass through to a so-called adder circuit. Thus, instead of transmitting the entire 2-megacycle component for each of the 3 colors, a dot sample is taken at regular intervals. The sampling sequence and the method of dot interlace for the samples taken in successive fields have been described in paragraphs 46 and 47.

52. The mixed highs are also fed into the adder circuit, referred to in the preceding paragraph. The appropriate synchronizing signals [3] are added at this point also and all the signals are then sent to the transmitter.

53. The apparatus utilized by RCA to demonstrate its system has already been described so far as the camera is concerned. The receiving apparatus demonstrated at the original October demonstration consisted of projection receivers, and direct-view receivers employing 2- or 3-color tubes and dichroic mirrors. The 2-tube dichroic mirror receiver, showing 2-color television, was not demonstrated again and an RCA witness testified that "the need for a 2-color process will be pretty much submerged" when a tricolor tube is developed. Likewise, the projection receivers were not exhibited again after the original demonstration, and until the April 6, 1950, demonstration all receivers shown by RCA contained dichroic mirrors and 3 cathode-ray tubes. At the April 6 demonstration, 2 models of a direct-view-color tube were demonstrated—1 with 3 electron guns and the other with a single electron gun. RCA described these tubes as follows: In each model the screen of the tube consisted of 117,000 groups with 3 primary color-phosphor dots in each group. Between the electron gun and the screen was a mask with 117,000 holes in registry with the dot groups. On the tube with 3 guns the signals were applied to the 3 guns in the same manner as to 3 separate kinescopes. The angle of arrival from each gun was so arranged that each beam hit the hole in the mask in such a way as to line up correctly with the appropriate dot of color phosphor. In the one-gun model the signals were applied to the gun sequentially and the beam was rotated by appropriate deflection circuits keyed to the sampler to insure the correct angle of arrival at the holes in the mask. An RCA witness testified that it was part of the RCA development program to increase the number of picture dots in the tricolor tube with a view to doubling them. The tricolor tubes demonstrated provided a picture about the size of a 14-inch monochrome tube, but RCA testified that there was no reason why a larger tricolor tube could not be made.

Mr. HARRIS. We have had presented to us a discussion on compatible and noncompatible systems, but we did not have the compatible broken down in line sequential system and dot sequential system, as it has been here today.

Now, do I understand from your discussion, the field sequential system would be more adaptable to UHF broadcasting?

[3] In addition to the usual horizontal and vertical synchronizing pulses, an extra synchronizing pulse, consisting of a burst of the sampling frequency, is added after each horizontal pulse during the blanking period. Its purpose is to keep the color sampler at the receiver and the one at the transmitter in step with each other.

Dr. STANTON. No; there is no distinction between UHF and VHF insofar as application of the field sequential system is concerned.

Mr. HARRIS. I notice in your statement; I observe that you had some discussion about proposing to the Commission and the industry the utilization of a wide band UHF; that was a system for color television which you were proposing.

Dr. STANTON. You are right. That was in 1946. We urged the adoption of a field sequential color system that would utilize wide bands in the UHF part of the spectrum.

Mr. HARRIS. That is because there was more space or wider bands available in UHF than there was in VHF?

Dr. STANTON. That is one reason. There is more elbow room up there and we felt that ultimately television was going to have to go into UHF, and we felt that would be the place to put color. That was in the 1946–47 round; but in 1949, when the Commission on its own motion called the color hearing, it set down certain criteria for the widths, or for the proponents to consider and one of them was that the system that the Commission would consider had to operate in a 6-cycle megacycle band obtainable in the VHF, so we proposed in 1949 the field sequential system at that time it did work in the 6-megacycle band in VHF and, of course, worked in the 6-megacycle band in the UHF; but in the 1946 period, when we were urging the use of UHF, that I think has brought about this question on your part.

Mr. HARRIS. You still hold the same viewpoint that it can be adopted to both UHF and VHF?

Dr. STANTON. Yes; I have not changed on that.

Mr. HARRIS. I should know this. What proportion of the 23,000,000 black and white sets are adaptable for receiving UHF?

Dr. STANTON. There is not a substantial number of UHF receivers, although there are adapters and converters in the field and some companies have built them into the receivers, but it is a very small part of the 23,000,000.

Mr. HARRIS. That was the next question I wanted to ask. What part of the 23,000,000 receive UHF?

Dr. STANTON. That is a statement that I would be glad to supply to the committee after I did a little study. I do not have the figures in my head, but I can almost say, I think, at this time, they were probably less than a million out of the 23,000,000 units.

Mr. HARRIS. Now, as I understand you are still of the opinion, from your experimental work, that the field sequential system is the system that is more likely to be developed on a more reasonable and practical side?

Dr. STANTON. Yes; I am still of that opinion, although as I tried to indicate, I am without full information on the system that has been proposed by the NTSC.

Mr. HARRIS. I appreciate that, and you have made it very clear in your statement, which is certainly a very practical position to take. I think everyone should fully appreciate that.

Is it going to be necessary for the Federal Communications Commission to adopt some definite standard before this entire program can ever be realized?

Dr. STANTON. In my opinion it is.

Mr. HARRIS. I may be wrong, but I understood the Chairman of the Federal Communications Commission to say to this committee a few days ago that insofar as the manufacturing of color television sets are concerned, the Commission had no authority whatsoever.

Dr. STANTON. Well, the Commission has no authority over that whatsoever, as I understand it, over the manufacture; but it has a direct influence or—yes, I would say direct influence on the manufacture, by the standards that are authorized for broadcasting. It is the lock and key principle.

Mr. HARRIS. I evidently misunderstood what he said, because I had the impression he said it was not the act of the FCC which kept this program from being developed.

Dr. STANTON. Well, I would not want to take issue with the Chairman of the FCC on that point. I think that the incompatible problem that I have outlined, plus the public announcement about a compatible electronic system being just around the corner would put up such a roadblock that I doubt that this thing can go ahead without the Commission giving a full investigation of the claims that have been made by this so-called compatible system.

Mr. HARRIS. Do you think there has been sufficient progress made on these different systems that the FCC could come to any definite conclusion on what standards should be set?

Dr. STANTON. I am not qualified to answer that.

Mr. HARRIS. I appreciate that it is a point in question.

Dr. STANTON. I think that the industry, if it has something, should take it to the Commission as rapidly as possible and clear the air once and for all on this question, because as surely as you are sitting here this thing is going to come up time and time again, if it is not cleared up.

Mr. HARRIS. I agree with you. In other words, I think we have to appreciate the fact that it has not been developed to the extent of permitting the Commission to make a definite finding yet. They are faced with a problem.

Dr. STANTON. This a gratuitous suggestion, but I do not think that the industry should be talking about having something that it is not prepared to go to the Commission with and have a definite determination of where it stands. I think it has an unsettling effect on the manufacturers that are not in the business. I think it has an unsettling effect on the public and an unsettling effect on the broadcasters.

Mr. HARRIS. Thank you very much. That is all.

Mr. SPRINGER. Mr. Chairman.

The CHAIRMAN. Mr. Springer.

Mr. SPRINGER. Dr. Stanton, you are president of a broadcasting company? I mean, you are president of the Columbia Broadcasting Co.

Dr. STANTON. I should explain that the Columbia Broadcasting System is made up of six operating units. One is the television network; one is the radio network; one is CBS Hytron, which is a tube manufacturing division; one is Columbia Records, Inc., which is a record manufacturing subsidiary; one is CBS-Columbia, which as I said is a radio and television set manufacturing subsidiary and the sixth division is what we call CBS Laboratories. Now, those six operating units comprise the Columbia Broadcasting System, Inc., and that is the parent corporation of which I am the president.

Mr. SPRINGER. You primarily make your money though in the broadcasting business; is that correct?

Dr. STANTON. I think it is fair to say, historically, if you took a long look, we have made most of our money in broadcasting. At the present time, however, what is happening to radio and with the high cost of developing television broadcasting, I would say manufacturing and broadcasting pretty well balance.

Mr. SPRINGER. Now, before you can expect the public to buy color television receivers, you have got to have programs, have you not?

Dr. STANTON. That is correct.

Mr. SPRINGER. Now, how many hours of programing does it take to attract any substantial audience.

Dr. STANTON. Well, if you have got a world series, that is one thing. If you have got a dull discussion program, that is quite another.

Mr. SPRINGER. About how many hours a day does it take your system to attract an audience; how many hours a day would you have to have to attract an audience; before people are going to buy television sets?

Dr. STANTON. I do not think that the thing can be reduced to hours, without some consideration of what the content is of the program.

Mr. SPRINGER. Let me ask you this: No one is going to buy a television receiver to receive an hour a day?

Dr. STANTON. They did.

Mr. SPRINGER. How long ago was that?

Dr. STANTON. Well, at the outset of television.

Mr. SPRINGER. Just an hour's broadcasting a day?

Dr. STANTON. I think in certain communities that it was that low; yes.

Mr. SPRINGER. Let me ask you this. Then, how many hours a day does your New York station broadcast?

Dr. STANTON. Oh, I think we are on the air from probably 8 o'clock in the morning until something like maybe 2 o'clock the following morning.

Mr. SPRINGER. And you have other stations in the same New York area broadcasting?

Dr. STANTON. There are seven stations operating in that area.

Mr. SPRINGER. You have how many receivers in that general area?

Dr. STANTON. I would say——

Mr. SPRINGER. A million or two million?

Mr. STANTON. It is of the order of 2 million, I suppose.

Mr. SPRINGER. How long does it take—how long did it take you to build up that; how many years?

Dr. STANTON. Well, from a practical point of view, that is 7 years.

Mr. SPRINGER. Seven years?

Dr. STANTON. Yes.

Mr. SPRINGER. Now, if you go into the color-television business, you are going to have to have programs to attract first of all, are you not?

Dr. STANTON. Absolutely.

Mr. SPRINGER. Now, how do you intend to start those programs?

Dr. STANTON. Well I think——

Mr. SPRINGER. I am asking for information, because I do not know which comes first, the chicken or the egg; broadcasting or the receivers.

Dr. STANTON. There is no question about it, that at this stage of the art it would have to be programing. I think that if we were start-

ing with television from zero time, and zero set-ownership, then they would come along a little bit together, a little bit better, but now black and white as well established as it is, it would take color programing of considerable significance to make the thing attractive to the public to purchase color receivers, unless, of course, they had this compatible feature. But, let me review the facts that when we undertook our programing schedule in June of 1951, we were planning to do so by sometime around that fall about 20 hours a week of color programing; some of that being in the daytime and some of that being in the evening.

Mr. SPRINGER. Now, is that experimental programing for you, or is that programing sold to the public at large?

Dr. STANTON. It is available to the public at large.

Mr. SPRINGER. For purchase if anyone wants to buy it?

Dr. STANTON. As advertisers?

Mr. SPRINGER. As advertisers.

Dr. STANTON. Well, we sold time to advertisers during that period that we operated.

Mr. SPRINGER. All right; during that time, did you operate at a profit or a loss?

Mr. STANTON. On color?

Mr. SPRINGER. Yes.

Dr. STANTON. On a loss.

Mr. SPRINGER. Now, how long do you think then that is going to take you after you get color television available before you operate at a profit on color television?

Dr. STANTON. It would depend upon the circulation we can sell to the advertisers and that is going to change, depending upon whether you are starting in an area that has not a large concentration of black and white sets, as against an area that has a large number of black and white sets which have to be converted to accommodate the field sequential system.

That is why we were so anxious when we were before the Commission to get a decision as early as possible so that that presented the minimum kind of a roadblock to the application after producing the system.

I am not trying to evade your question.

Mr. SPRINGER. I understand that.

Dr. STANTON. But, the question seems to me to break down into two parts.

First, we are talking about a field sequential system, and you have got one set of conditions. If you are talking about a compatible system, of equal performance and cost, then you have got a different set of conditions.

Mr. SPRINGER. Under which one of those is it going to be the most favorable condition for you to produce, in CBS?

Dr. STANTON. At this stage of television development, if the ssytem, if the compatible system gives a good clear picture at a reasonable price to the public, there is no question but what at this stage of the art and development we would be better off from a broadcasting viewpoint with the compatible system.

Mr. SPRINGER. Now, there is just one question, and this is going back—not covering rough ground. But actually it probably would have have been a mistake, would it not, if you had gone in with a non-

compatible system and broadcast at that time, where you would have been, as I understand, in a 2-receiver situation. One would be black and white, and the other would be a color receiver.

Dr. STANTON. Not entirely. You would have been in with a combination, in most cases I think; with a combination receiver that would receive color and black and white.

Mr. SPRINGER. You mean together on the same frame?

Dr. STANTON. On the same picture tube.

Mr. SPRINGER. Would that have cost substantially more to do that?

Dr. STANTON. You are addressing yourself to the question now as to the consumer or the broadcaster?

Mr. SPRINGER. To the consumer.

Dr. STANTON. A combination unit would have cost more than a straight black-and-white unit set; yes.

Mr. SPRINGER. How much more would it have cost?

Dr. STANTON. I think that has been variously estimated. I think I can refer to some of the testimony put in at the time of the hearing. I think one of the witnesses at the time of that hearing estimated that it would add $75 to $80 to the cost of a black-and-white set to have the combination color and black-and-white receiver.

Mr. SPRINGER. Now, I understood yesterday—I might have misunderstood Dr. Engstrom, and I do not want to misquote him. I will let the record stand as to what the truth was—but, I understood him to say that it would cost about 50 percent more at that time. In other words, if your set, black-and-white set cost $300, a combination set would cost $450; if a black-and-white set cost $400, that combination would cost $600.

The CHAIRMAN. Will the gentleman yield?

Mr. SPRINGER. I will yield to the chairman.

The CHAIRMAN. I think he also made some reference to 25 percent.

Mr. SPRINGER. All right. We will let the record stand for whatever it is.

Dr. STANTON. Was he not referring in that testimony to the proposed compatible system? Because the figure I have been giving you here from the testimony before the Commission is talking about the field sequential system. I just want to make the record clear on that. I want to be sure that we understand each other.

Mr. SPRINGER. Let me say this: If you are going to broadcast in color, I would take it that your proposition of selling advertising in the future would be on the basis that you can receive both programs.

Dr. STANTON. Yes.

Mr. SPRINGER. Would there be much of a market if you did it solely on a color-television receiver?

Dr. STANTON. Well, in those parts of the country that have no television at all and are going to start up with television sometime within the next couple of years, depending upon when they can get construction permits, I think it would be much easier there, because you would not have to overcome this resistance that you would encounter in the highly concentrated areas such as New York and Pittsburgh today. It will vary, depending upon the locality.

Mr. SPRINGER. I am interested in hearing you say that, because Dr. Engstrom's statement, I think, is in direct conflict with that. I believe he said that color would always cost more—and I use the words advisedly—will always cost more, because of the fact that you

have to put more into the receiver and it is going to cost more to build the receiver for color television than for black-and-white television.

Dr. STANTON. I do not have the advantage, of course, of knowing what system Dr. Engstrom was testifying about yesterday. But I can certainly say this on the field sequential system, which I think is a similar system, the margin would not have been a substantial margin between color and black-and-white when we once got into mass production. At the outset, of course, it would cost more.

Mr. DEROUNIAN. Will the gentleman yield?

Mr. SPRINGER. I will yield.

Mr. DEROUNIAN. I think that Dr. Engstrom said that it would cost more to broadcast color, because you would have to have color consultants; you would have to have color costumes and things like that in the production and sending end.

Mr. STANTON. That is another part of the equation, and I do not share that opinion that was given yesterday. Our experience does not indicate that there is a great deal of added cost in the production of shows. We live in a world of color. The costumes that people ordinarily wear are colored costumes. We do not make up clothes in black and white for black and white. We used colored costumes in productions today. All of our outdoor television is the same. Take the Easter parade that is coming up, and so forth, that will be just the same. There will be no added cost there. With our system we require no special change of transmitter. Once you have invested in the camera equipment that is all there is to it.

Undoubtedly there will always be creative people who want to do extra things to get extra effects, but that is going on with black and white just as well as color, for the same effect purposes, and I do not think from a broadcasting point of view that color is going to present any substantial increase in cost; certainly nothing like the added cost at the outset that it will cost the consumer to buy the set.

That is what I was coming back to on the question of the color film, because color film costs more than back and white. That is always one of the reasons why technicolor costs more; it might cost more to print color than black and white printing.

But in this case, it does not cost anymore to transmit color out of a transmitter; it does not cost any more, in my opinion, than to transmit black and white.

Then, one of the advantages is that you get so much more in the way of intelligence, and for that there is no real additional increase in the cost of producing the product.

Take all of our sports programs. No color technician is required for those. No special costumes or anything of that kind is required. You cannot change the color of grass, no matter how much you try.

Mr. SPRINGER. The question of standards has been raised in this hearing. I think it is awfully important, because I understand that the FCC has set certain standards, and those standards are more or less the standards that you will have in either the compatible or the sequential system.

Dr. STANTON. It is the identical standard.

Mr. SPRINGER. Now, let me ask you this. Are you familiar with the standards of the National Television System Council or Committee, or whatever it is? Are you familiar with those standards?

Dr. STANTON. No; I am not.

Mr. SPRINGER. Are you in a position to risk a statement at this time as to whether the standards for receiving would be higher under their system than under the sequential system?

Dr. STANTON. I do not believe I am in a position to give an answer on that, because I would want to study that with our technical people. Certainly our technicians are keeping up to date on this problem, but I am not in a position to answer.

Mr. SPRINGER. For instance, there is one thing, as I understand, under the sequential system, you have 405 lines and that under the National Television System's Committee system you have 525 lines, which makes a considerable distance, as I understand, in the picture.

Dr. STANTON. Well, it is not as simple as that mathematical statement would lead you to believe.

Mr. SPRINGER. I am just asking about that one standard. I understand that the 525 makes up the whole standard.

Dr. STANTON. Yes, except I would not want the record to stand on the basis that the change in what you get is of the order of 525 to 405. I think that the psychological impression, or the response that you get with your eyes, if you look at the field generally and the so-called NTSC picture would not be of the order that you have indicated at all. In fact, if the experience we have had in the past in the demonstrations that the Commission had submitted to it in 1949 and 1950, are referred to, you will find that the picture quality of the 525 was below the picture quality of the 405 of the field sequential.

That is one of the bases on which the Commission made its finding.

Mr. SPRINGER. You make that comparison on color?

Dr. STANTON. Yes.

Mr. SPRINGER. Right now, let me ask you this. Do you believe it would be better to start with the standards which are worked out for color, the same as it has done for black and white—523?

Dr. STANTON. I think that if you can give any, or some reasonable assurance that you are going to be able to achieve the standards, the full standards that you are stating, I would naturally start where I can get the best end position. But, that was not the case at the time of the 1949–50 hearings and these demonstrations.

Mr. SPRINGER. What was the conclusion then?

Dr. STANTON. Well, I do not have a copy of the Commission's report here; but the Commission made it quite plain in its findings that the picture quality, both as to definition and as to color was substandard on the 525–line compatible system and I think if the committee is interested in that that perhaps that ought to be submitted as a part of this record, because it is spelled out very clearly on the part of the FCC.

I have the full report here now, that my associate has given me. This is First Report of the Commission (Color Television Issues) which was adopted September 1, 1950, on the question of a number of issues that were considered during the hearings. In section III of the report they evaluate the three systems and they took up such things as flicker, motion continuity, and allied effects.

Then they discuss the CTI system; they discuss the CBS system and the RCA system under that particular set of criteria.

Then they take the subject of brightness-contrast and deal with the three systems there.

Then they took up superposition of color image and discuss that. Then they took up the question of color fidelity and I think that is what we are getting close to and what we are talking about here.

Mr. SPRINGER. That is a part of it.

Dr. STANTON. Then they took up the question of resolution, and that again is what we are talking about, and then they took up the question of picture texture; then the susceptibility of interference, the adaptability and convertibility, and they went through all of these factors and they came out with their conclusion for each one of them.

But, going back to color fidelity, in respect to the CBS system on page 35, paragraph 86. I am quoting from the record.

The color fidelity of the CBS system as demonstrated on the disc receiver has been of a uniformally high quality. No determination can be made on the record as to whether receivers utilizing a direct view tricolor tube can achieve the same uniform high quality of color fidelity as disc receivers. This is due to the fact that there is no evidence in this record that color phosphor surfaces have been developed to the point where they produce colors as accurately as a filter, and also because a tube utilizing separate color phosphors loses the advantage of the use of a single viewing surface for all three colors.

Then referring to the RCA system, paragraph 87:

87. At all of the demonstrations on the record, RCA had difficulty producing a color picture with adequate color fidelity.

And then it goes on at great length about that; with considerable technical language. I can supply it if the committee wants me to but on the question——

The CHAIRMAN. I would suggest, Dr. Stanton, that you put into the record at this point whatever you feel is necessary to answer the question that has been propounded to you.

Dr. STANTON. Thank you.

(The information requested follows:)

EXHIBIT B

(From the First Report of the Commission (on Color Television) adopted and released on September 1, 1950)

THE CBS SYSTEM

74. The amount of brightness which can effectively be utilized is determined by the flicker level. This figure is 20- to 30-foot lamberts on CBS disc receivers. The maximum figure achieved for a disc receiver at a demonstration on the record was 22-foot lamberts. We are of the opinion that the color picture so produced is bright enough and has sufficient contrast range to be entirely adequate for use in the home under normal viewing conditions. Indeed, the CBS demonstrations were the only ones that were conducted in a lighted room, and during one of the demonstrations a light from a 300-watt lamp was thrown directly on the face of the receiver without seriously affecting the quality of the picture. This is possible because the disc operates as a two-way filter so far as illumination in the room is concerned; that is, any light that is reflected from the tube which originates in the room must pass through the disc on its way to the tube, and the light that is so reflected must pass through the disc again on its way out. By way of illustration, if the disc utilized permits 10 percent of the light to pass through, filtering out 90 percent, it would be possible to view a 20 foot lambert picture on the CBS disc receiver in a room with an illumination of 67 foot lamberts and still retain a contrast ratio of 30 to 1.[1]

75. As was pointed out previously, higher brightnesses without flicker are possible in the CBS system by the utilization of tubes with long persistence phos-

[1] For a 20 foot lambert picture, the reflected light cannot exceed 3/10 of a foot lambert on a 30 to 1 ratio. If the ambient illumination at the receiver is 67 foot lamberts, this is reduced to 0.7 foot lamberts on the way through the disc to the tube and this in turn is reduced to 0.67 foot lamberts on the way out through the disc.

phors. Tubes with long persistence phosphors cannot be utilized on disc receivers without a problem of color contamination, and the disc would not be present to serve as a filter. The viewer could have a neutral density filter on his receiver to improve contrast in the same way as on a black and white receiver.

THE RCA SYSTEM

76. At none of the demonstrations on the record did any of the RCA color receivers produce sufficient illumination for ordinary home use. Indeed, all of the RCA demonstrations on the record were conducted in a room with virtually no illumination. While equipment can undoubtedly be developed that will produce higher brightness, there is some doubt—which can be resolved only by further testing—as to whether the duty cycle of the RCA system will permit much higher brightness on the tricolor tube. Moreover, the RCA system has difficulty in maintaining adequate contrast, particularly in small areas. This defect appears to be due to the use of the mixed highs principle, cross talk, and to the efforts made to smooth out the dots as much as possible so as to avoid the appearance of dot structure in the picture.

THE CBS SYSTEM

81. The CBS system is not troubled by other than minor registration problems either at the camera or receiver. These minor problems arise from power supply hum, stray fields, and vibration but they are easily cured. The reason why no fundamental registration problem exists is that only a single tube is utilized both at the camera and disc type receiver; the field sequential system is the only one that can do so.[2] Hence, the response of the scanning beam is the same for each color and each field. At none of the demonstrations on the record did the Commission observe any evidence of misregistration.

82. Color breakup and color fringing were observed at the demonstrations on the disc receivers. The use of tubes with long persistence phosphors should minimize color breakup at the receiver. Color fringing, moreover, will still occur due to the use of the color disc at the camera.

THE RCA SYSTEM

83. Registration, both electrical and optical, is a severe problem both at the camera and receiver. At the camera this is due to the fact that three separate pickup tubes are utilized. The optical system must be so adjusted and maintained that the image being scanned falls upon the three tubes in exactly the same relative position. Three separate electrical signals of exactly the same linearity must be generated. Even if equipment is originally constructed that could meet this test, it is extremely doubtful that such precision could be maintained. The rate of deterioration is likely to differ for each of the three tubes. The same problems are also present on the three tube receiver. RCA demonstrated a receiver employing a single tricolor tube in which it was claimed correct registration was built into the tube.[3] It should be noted, however, that at all of the demonstrations on the record, there was evidence of faulty registration. This was also true of the demonstration on April 6 where the tricolor tube was shown. Of course, such misregistration may have been the fault of the camera rather than the receiver since a misregistered picture results if there is misregistration in either the optical or electrical aspects of the camera or receiver. Hence, even if the tricolor tube does have correct registration built into it, misregistration results at the receiver unless misregistration is corrected at the camera. The problem has not been solved by RCA at any of the demonstrations on the record when only indoor equipment was utilized. The problem by its nature is bound to be far more difficult in the case of outdoor pickups and RCA has not demonstrated any outdoor pickup camera. RCA did testify that a single tricolor tube could be developed for the camera which would have correct registration built into it. No such tube was demonstrated nor was there any testimony that one had been constructed. It is difficult for the Commission to see how the RCA system could utilize such a tube even if one were constructed. The principle of mixed highs upon which RCA relies so heavily requires by its very nature a simultaneous camera pickup of 3 color signals.

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[2] As will be pointed out later, if a tricolor tube is developed which can be utilized without the disc, it will have to have correct registration built into it to be capable of use.

[3] See paragraph 53.

THE CBS SYSTEM

86. The color fidelity of the CBS system as demonstrated on the disc receiver has been of a uniformly high quality. No determination can be made on the record as to whether receivers utilizing a direct view tricolor tube can achieve the same uniform high quality of color fidelity as disc receivers. This is due to the fact that there is no evidence in this record that color phosphor surfaces have been developed to the point where they produce colors as accurately as a filter, and also because a tube utilizing separate color phosphors loses the advantage of the use of a single viewing surface for all three colors.

THE RCA SYSTEM

87. At all of the demonstrations on the record, RCA had difficulty producing a color picture with adequate color fidelity.[4] The difficulty undoubtedly arises from several factors which are part of the RCA dot sequential system. In the first place, registration is most difficult to maintain and when misregistration occurs there is color contamination and a loss in resolution. In the second place, color control is exceedingly difficult to maintain. A time error of only 1/11,000,0000 of a second in the sampler, results in the wrong color being transmitted or received. In the third place, the utilization of mixed highs, cross talk, and the fact that the colored dots are larger than a single picture element appear to prevent the production of color detail in small areas over the entire picture. In the fourth place, the fact that the three primary color images are scanned on three separate surfaces at the camera, makes it exceedingly difficult to obtain uniform sensitivity for all colors over the whole picture area. The result was that color fidelity of a high quality was not consistently achieved at any of the demonstrations on the record and in particular there was no real success in correctly reproducing skin tones. All of these difficulties will undoubtedly be aggravated on outdoor pickups as will be more fully explained in paragraph 118. So far as the tricolor receiving tube is concerned, the RCA picture also suffers from the limitations as to color fidelity which are involved in the use of color phosphors rather than filters.

THE CBS SYSTEM

90. The CBS system produces 405 lines per picture as compared with 525 lines per picture for the present system. Hence, as is to be expected, the vertical resolution of the CBS picture is below that of the present system. The use of 144 fields per second, with a resulting line scanning rate of 29,160 per second, results in a loss of horizontal resolution. There is a reduction in vertical resolution by 23 percent and horizontal resolution by 46 percent as compared with the present system. By utilizing horizontal interlace and retaining the horizontal scanning rate suggested by CBS, the vertical resolution would still be reduced by 23 percent but the horizontal resolution would be approximately the same as monochrome. Further testing is required in order to determine whether this increase can be achieved in practice.

THE RCA SYSTEM

91. Although the RCA system produces lines at the same rate as the black-and-white system, its resolution even in theory is not equal to that of the present system for all types of scenes. The vertical resolution should approach that of the present system but the horizontal resolution ranges between 67 percent and 100 percent of the present system. This is probably due to cross talk and the use of mixed highs. Moreover, if in the scene being scanned there are two adjacent areas of different colors which are of equal intensity, no mixed highs would be generated, and in this type of situation the horizontal resolution could be reduced to as little as 33 percent. Finally, in practice, the RCA resolution has suffered from the misregistration which has been present at each of the demonstrations on the record.

THE CBS SYSTEM

94. At all of the demonstrations on the record, the CBS picture compared favorably with the present system so far as contrast, sharpness of picture, and

[4] Although there is some testimony that at times the color fidelity of the RCA picture was adequate, this was achieved either at a special demonstration not on the record or sporadically on the record.

freedom from line structure are concerned. As above stated, the geometrical resolution of the CBS picture was inferior to a picture under the present standards.

95. During the course of the hearing there was a good deal of discussion concerning "crispening" in the CBS system, whereby apparent definition is improved by making the picture appear sharper. Crispening circuits do have the capacity of producing sharper pictures. While their use may not be limited to any one system, no demonstration of crispening was had with any of the other systems, and, accordingly, it is not possible to determine what the extent of improvement for these systems would be. Moreover, it is doubtful whether crispening can be utilized by a system employing horizontal interlace.

96. If horizontal interlace were utilized on the CBS system, the picture texture could be affected thereby. Dot structure or twinkle could appear in the picture. CBS testified that this could be avoided in its system utilizing horizontal interlace. Satisfactory proof of this point requires further testing.

THE RCA SYSTEM

97. The RCA picture has a "soft" quality when compared to pictures of the present system. This is probably due to the difficulty in maintaining contrast, particularly in small areas. Picture texture was also marred at all of the demonstrations on the record by the visibility of dot structure at distances at which the lines begin to be unresolved. RCA testified that the dot structure could be minimized by the use of electrical filters, but no demonstration of this process was made on the record. Moreover, it appears to the Commission that if the dots are smoothed out, the consequences are likely to be a loss in resolution or contrast, or in both.

THE RCA SYSTEM

132. The RCA system also falls short of the criteria set forth above. In the first place, the color fidelity of the RCA picture is not satisfactory and it would obviously not be in the public interest to adopt as standard a color system which does not produce a satisfactory color picture. At none of the demonstrations on the record could RCA consistently produce pictures with adequate color fidelity. The inability accurately to reproduce skin tones is a particularly serious handicap. There appears to be no reasonable prospect that these difficulties in the RCA system can be overcome, because of misregistration, mixed highs, cross talk between picture elements, and criticalness of color control implicit in a system where a time error of 1/11,000,000 of a second results in color contamination.

133. In the second place, the texture of the color picture is not satisfactory. At all of the demonstrations the quality of the picture was marred by misregistration and also to a certain extent by dot structure. Indeed, even on the score of compatibility the quality of black and white pictures which existing sets receive from RCA color transmissions is somewhat degraded because of dot structure and misregistration at the camera; however, the black-and-white picture remains of reasonably good quality. Moreover, the RCA color picture has a "soft" quality, probably due to the difficulty in maintaining contrast, particularly in small areas. It is difficult to see how these defects can be eliminated. Correcting misregistration in the RCA system is an exceedingly difficult task as has already been indicated. Smoothing out the dot structure can mean losing resolution or contrast, or both. Poorness of contrast, particularly in small areas, appears to be the price of mixed highs, cross talk, and dots which are larger than single picture elements.

134. In the third place, the receiving equipment utilized by the RCA system is exceedingly complex. The Commission would certainly not consider adopting a system which was limited to receivers of the dichroic mirror type demonstrated on the record. These receivers are so bulky, so complicated, so difficult to operate, and so expensive that it is inconceivable that the public would purchase them in any quantity. RCA did demonstrate a receiver using a direct view tricolor tube towards the end of the hearing but the Commission is not satisfied that the tube solves the problem of complex receivers. The tube was not demonstrated until late in the proceedings and has had very little field testing. It has not been available to other parties or the Commission's laboratory for the purpose of checking its operation. As demonstrated, the tube had an inadequate number of dots, produced insufficient illumination, and had a serious moire pattern in it. There is no assurance that the tube will not be unduly expensive, for while an RCA witness testified that the tube would cost 50 to 100 percent more than black-and-white tubes of corresponding size, no data were submitted

in support of this estimate. Finally, even though the tube is developed, there is no assurance that the receivers will not continue to be unduly complex and difficult to operate. Since a time error of 1/11,000,000 of a second results in color contamination, it is difficult to see how color control can be simplified to a sufficient extent for home use.

135. In the fourth place, the equipment utilized at the station is exceedingly complex. There is no assurance that satisfactory commercial type equipment can be built because at not a single demonstration on the record was accurate registration maintained throughout the demonstration. Moreover, there is such great difficulty in maintaining the equipment in the precise operating condition which the system entails that it is extremely unlikely that the job could be done by an organization that does not have an extensive staff of research personnel and engineers at its disposal. The type of trained personnel which is generally available to the average station could hardly be expected to handle such a difficult job. The above difficulties will be particularly onerous in the case of outdoor pickup equipment which is subject to much harder use and rougher handling than studio equipment. RCA did not demonstrate any outdoor pickup equipment.

136. In the fifth place, the RCA color system is much more susceptible to certain kinds of interference than the present monochrome system or the other two color systems. A demonstration of oscillator radiation such as would be received from other television receivers not only caused severe interference to the picture but under certain conditions upset color synchronization so that color control was lost.

THE CBS SYSTEM

140. This leaves for consideration the CBS system. In the Commission's opinion, the CBS system produces a color picture that is most satisfactory from the point of view of texture, color, fidelity and contrast. The several demonstrations on the record included a wide variety of subject matter both in the studio and out of doors and the picture which resulted was in each case entirely suitable for home viewing purposes.

141. Receivers and station equipment are simple to handle. They have been subjected to use in widely diversified circumstances and no difficulty has been encountered. The receivers are simple and when produced on a mass marketing basis, should be within the economic reach of the great mass of purchasing public.

142. The susceptibility to flicker in the CBS system is greater than in the present monochrome system but in the Commission's view the brightnesses that have been achieved on disc receivers are adequate for home use and the evidence concerning long persistence phosphors shows that there is a specific method available for increasing brightness on nondisc receivers with no objectionable flicker. The CBS system is subject to color fringing or color breakup under certain circumstances. This is not a serious obstacle for two reasons. In the first place, many viewers after awhile tend not to see these defects. This is evident from a comparison of the little amount of comment on this subject in this hearing, compared to the 1946-1947 hearing. In the second place, these effects occur rather infrequently and many of them can be minimized in programming techniques. When they do occur, they are no more annoying to the viewer than stroboscopic effects in motion pictures.

143. The CBS system has less geometric resolution than the present monochrome system but the addition of color more than outweighs the loss in geometric resolution so far as apparent definition is concerned. Of course, owners of receivers which have adapters but which are not built for color will receive only a black and white picture from CBS color transmissions—a picture which will not have color to compensate for the loss in resolution. However, this is a matter of choice for the viewer; he can have color if he so desires. Moreover, the black and white picture he receives from CBS color transmissions is still an acceptable picture; the degradation is of the order involved when black and white pictures are transmitted over the coaxial cable. There appears to be no alternative to some degradation in the quality of the black-and-white picture from color transmissions since even the so-called compatible systems suffer from the same failing.

Mr. SPRINGER. Now, one further question, Dr. Stanton. If the National Television Systems Committee comes to the end of their tests, which I understood from Dr. Engstrom yesterday, would be within a

time that is reasonable, but by July or August, do you believe that the hearings on this question should be put off until that time?

The CHAIRMAN. May I ask whether by "hearings" you mean hearings by this committee or by the Commission?

Mr. SPRINGER. By the FCC.

Dr. STANTON. Well, I think from a practical point of view, we have no alternative. It certainly would not be fair to demand that they come in tomorrow if they are not prepared to come in tomorrow.

I think from a practical point of view, if that is the way it is, that is the way that it will have to be, because I do not see any alternative course of action. I do not think that the manufacturers are going to start making receivers for the field sequential system, knowing that that is coming up in July, or even a year from July. I do not think that the broadcasters will start to broadcast if they know that is coming.

Therefore, I think the earlier that it can be handled, the better, but if July is as early as possible, then I would have to accept that as July.

Mr. SPRINGER. That is all, Mr. Chairman.

Mr. SCHENCK. Mr. Chairman, I want to make a statement and ask two questions; one is in order, and one perhaps is out of order.

The CHAIRMAN. We will permit you to proceed, in view of the fact that you have such a high regard for the witness.

Mr. SCHENCK. Thank you.

First, I want to say that I think the testimony the witness has given is a complete justification of my confidence in him, and my pride in the fact that he and I both come from Dayton, Ohio.

The CHAIRMAN. It is one further evidence that your judgment is always good.

Mr. SCHENCK. Thank you.

Now, I would like to ask Dr. Stanton, would a regular set now, receiving set, that I might have in my home now need some kind of a gadget to receive a clear picture in black and white, if they were broadcasting in color under this compatible system?

Dr. STANTON. No; as I understand the proposal, the compatible system, your present black-and-white receiver would respond to color signals and you would receive those as black and white pictures, on your existing receiver.

Mr. SCHENCK. Now, the other question that I had in mind, out of order, is this: If this is not proper and you do not want to answer it, all right.

A few days ago in discussing the question of networks operations with the Chairman of the Federal Communications Commission I asked the question and he indicated—I asked the question as to whether he thought the Federal Communications Commission should have some control over networks operations in broadcasting. He indicated he though they should. I wonder if you share that view, or if you feel that the Federal Communications Commission should not have control over networks operations.

Dr. STANTON. Well, speaking independently to that question, I do not think they should have supervision over networks operations. Actually we are licensed by the Commission insofar as we own and operate radio and television stations. So that like any other licensee they have that kind of supervision over our activities insofar as our

operations and standards are concerned, and so forth. I do not think it is necessary for the FCC to have license control of networks operations.

Mr. SCHENCK. Well, I am thinking of a station, perhaps a new station, in a community which is going in against some other local competition which already have their networks set up and the new station cannot get them.

Now, that is the point of control—the networks distribution.

Dr. STANTON. We have always had that condition, that is, we had four networks back in the days of radio; you had many communities where there were more stations than there were networks servicing them and in some communities you had fewer, of course; but I think with the network structure in this country, you can expect that to continue in television as it did in radio; but I do not see anything harmful in that.

Mr. SCHENCK. Thank you very much.

I will say, Mr. Chairman, I am still happy about the witness.

The CHAIRMAN. Are there any further questions?

Mr. PELLY. Mr. Chairman.

The CHAIRMAN. Mr. Pelly.

Mr. PELLY. Dr. Stanton, briefly, would you tell us, do they have color television abroad? Are there any programs being broadcast in England or other countries now?

Dr. STANTON. The best of my knowledge there is none on a regular basis. I believe that there were some color demonstrations in Paris and I believe there have been some color works on in London.

Mr. PELLY. What system were they using?

Dr. STANTON. In both cases they have been using a field-sequential system. There may have been demonstrations involving some other system, but I am not familiar with those demonstrations; but I want to make it clear that those are not regular broadcasts.

Mr. PELLY. Have they had any order there similar to M–90, which would have impeded the progress of their development?

Dr. STANTON. Well, you have got a lot more than M–90 in both Paris and London.

In London or in England, you have the BBC system of broadcasting, a noncompetitive monopoly system where you only have one program service in television and you have a license fee that the broadcaster has to pay to have a television set and in addition to that you have tremendous shortages of materials so that there is a very high purchase tax—I think of 66 percent—on the price of the receiver and you have shortages of glass and steel, which have made it impossible for them to go ahead with mass production anything like the mass production we have had in this country. So, it is much broader than M–90, the M–90 situation. What the problems are in Paris, I do not know. The French are operating on a different set of standards from the British and the British are operating on a different set of standards than the Dutch, and it is a confused picture, to say the least.

The BBC, by the way, is using 405 lines, which is what we had on our field-sequential system here.

Mr. PELLY. In other words, they do not have to have an order such as M–90 to hold them back on strategic materials?

Dr. STANTON. Well, I think—I am certainly no expert on the domestic economy in Great Britain—but as I understand their shortages are such over there that they are held back all of the way along for domestic use of critical materials, and certainly the copper and steel and so forth that are in television sets fall in that critical area. So, I do not think we can discuss their situation as a parallel to ours in any way.

Mr. PELLY. They have gone ahead with jet planes, jet engines, and we have been left behind them, and I was wondering about their scientific developments and technical studies—whether they were making as much progress over there—or lack of progress probably I should say, as we are over here.

Dr. STANTON. Well, the parallel between the British broadcasting and American broadcasting never has been too close, because of the fundamental differences in the two systems, whether radio or television. For example, the BBC broadcasts a few hours in the afternoon; 1 hour for children and 1 hour for women, and then they shut their transmitters off and they come on again after several hours, and then they go silent to broadcast the news. They do not broadcast as we do.

Mr. PELLY. What I mean more than anything else is, do they have patents which we exchange with them, or information, or what is the situation so far as their technical development goes, even if they broadcast only an hour a day, what is their progress?

Dr. STANTON. Well, I think that their progress in terms of equipment is below the progress we have made in this country, without a question. Just take the size of the picture. They are very apologetic about the fact that they only have 12- or 14-inch pictures even with black and white. We have much larger tubes than that in black and white and even larger tubes than that in color.

Mr. PELLY. Thank you very much.

The CHAIRMAN. Are there any further questions?

If not, I want to express again on behalf of the committee, Dr. Stanton, my very great appreciation for the splendid statement that you have made and for the help that you have given this committee in what we consider a very important matter and to which we are giving our most careful attention.

Dr. STANTON. Thank you, Mr. Chairman.

The CHAIRMAN. The committee will stand adjourned until 10 o'clock tomorrow morning.

(Thereupon, at 12:23 p. m., the committee adjourned to meet at 10 a. m. the following morning, Thursday, March 26, 1953.)

COLOR TELEVISION

THURSDAY, MARCH 26, 1953

HOUSE OF REPRESENTATIVES,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The committee met at 10 a. m., pursuant to adjournment, in room 1334, New House Office Building, Hon. Charles A. Wolverton (chairman) presiding.

Mr. HINSHAW. The committee will come to order.

STATEMENT OF RICHARD HODGSON, PRESIDENT, CHROMATIC TELEVISION LABORATORIES, INC., NEW YORK CITY

Mr. HINSHAW. The first witness this morning will be Mr. Richard Hodgson, president of Chromatic Television Laboratories, Inc., and a graduate engineer. He was born in northern British Columbia of United States parentage and received his early education in Colorado and California.

His engineering training and degree was obtained at Stanford University, followed by a graduate degree from Harvard.

At the outset of the war, Mr. Hodgson became associated with the radiation laboratory of the Massachusetts Institute of Technology and participated in the fundamental development and application of microwave radar equipment. During this period, he worked in close association with Dr. Lawrence, Dr. Alvarez and others now associated with the development of the Lawrence color tube.

Later Mr. Hodgson also worked with the Office of the Secretary of War, acting as civilian technical adviser to Gen. Hoyt S. Vandenberg now commanding general of the Air Force. More recently, Mr. Hodgson served as a member of a small group, headed by Lt. Gen. James Doolittle, which aided in the reorganization of the research and development activities of the Air Force.

Following the war, Mr. Hodgson was active in the establishment of the Brookhaven National Laboratory which was set up as a research center in nuclear physics. He served as manager of its engineering division.

In 1947, Mr. Hodgson joined Paramount Pictures and assumed direction of that company's television development programs. When Chromatic Television Laboratories was organized in 1950, he became president of that company and continues to serve in that capacity.

The committee can see that Mr. Hodgson is an old hand at radiation problems. I understand, however, that this is the first time that Mr. Hodgson has appeared before a congressional committee. I am sure that Mr. Hodgson's appearance before this committee gives us

great pleasure. I hope that he likewise will feel that his appearance here before us has been a pleasant experience for him.

Mr. Hodgson.

Mr. HODGSON. Thank you, Congressman Hinshaw.

I am afraid my parents did not have this committee meeting in mind when they chose where I was going to be born; not only was it out of the country, but the town does not even exist any more. So, I do not expect any support here locally.

My name is Richard Hodgson. I am president of Chromatic Television Laboratories, Inc., and on behalf of my associates, I wish to express our appreciation to this committee for inviting us to participate in this hearing.

Chromatic was organized for the purpose of developing some basic concepts about color television conceived by Dr. Ernest O. Lawrence, inventor of the cyclotron, winner of the Nobel Prize, and presently director of the University of California Radiation Laboratory. Associated with Dr. Lawrence in Chromatic's development work are a number of other eminent scientists, such as Dr. Edwin N. McMillan, also a winner of the Nobel Prize for his work as codiscoverer of plutonium, Dr. Luis W. Alvarez, inventor of the widely used ground control approach system for aircraft navigation, and Dr. M. G. White, in charge of nuclear physics at Princeton University, and others.

Chromatic operates a research and development laboratory in New York City and another in Oakland, Calif. Associated with the Oakland laboratory is a color tube pilot production plant. The preliminary development work on the Lawrence tube was done first in Dr. Lawrence's own shop and subsequently, on a broader and more intensive basis, at Chromatic's Oakland laboratory. Chromatic is also engaged in research work for the Air Force and the Navy under a series of research and development contracts. Our operations have been financed by Paramount Pictures Corp., which has an ownership interest in the company.

CHROMATIC VIEWS ON COLOR STANDARDS

For the past 2 days, this committee has been hearing various experts regarding the troublesome problem of color standards. There can be no doubt that the controversy over standards has been and still is a serious factor retarding the development of commercial color television. The constructive interest taken by this committee in seeking to hasten the final determination of standards is most encouraging to those of us who are eager to bring color to home television viewers as soon as possible. Chromatic's position in this regard has been consistent. Permit me to quote from a statement made by Chromatic to the Federal Communications Commission on June 26, 1950, just prior to the adoption of the field sequential standards:

> Chromatic is not advocating a particular system or systems. * * * Its interest is in the establishment of standards that will make possible the most rapid progress in the development of a competitive nationwide television service which can utilize all of the advances of the art including color. * * *
>
> It is the belief of Chromatic that the most important factor in achieving the fullest and most effective utilization of television frequencies is the adoption of standards that will result in a color picture of sufficient brightness so as to

make television a cultural and educationally useful instrument at any time of the day and at any place or under any reasonable conditions.

In the interest of completeness and fairness, I should add that Chromatic in this same presentation urged a year's moratorium on any standards decision so that new developments might have an opportunity to meet the limitations of the proposed systems. We also insisted that the existing record of performance precluded the adoption of any other than the field sequential system. Because of the problems of compatibility, we felt that field sequential implied a new type of service and therefore urged that the Commission consider requiring all UHF stations to transmit in color and establish an allocation plan which would permit each VHF license to be assigned to UHF channel with the requirements that color be broadcast simultaneously. The FCC did not adopt this plan, but did approve the field sequential system.

We pointed out at that time that the decision in fixing standards would seem to involve the relative merits of ultimate obsolescence for the then existing 5 million television receivers against an economic low-cost color receiver for 40 million homes. It was a grave dilemma which faced the FCC at that time.

INDUSTRY DIFFERENCES ON NTSC STANDARDS

This proceeding has unexepectedly emphasized the differences of opinion that exist in this industry as to what the effects of the NTSC standards might be. The statement by the RCA representative that the additional cost of a color receiver over a black and white receiver might range from 25 to 50 percent is proof of this fact when contrasted with current statements by other industry spokesmen. I quote an article in yesterday morning's New York Herald Tribune·

SET MAKERS PLAN CAMPAIGN

TV set manufacturers prepared yesterday for a compaign designed to discourage a wait-and-see attitude among prospective customers.

Presidents of several New York manufacturers conceded that reopening of color TV hearings would tend to slow buying of standard black-and-white receivers.

"We've got to convince them that there will be no mass production of color sets before mid-1955 at the earliest," said Benjamin Abrams, president of Emerson Radio & Phonograph Corp.

Mr. Abrams suggested the best way to discourage the wait-and-see attitude would be for the industry to show the best color TV sets currently available.

HOPES "PUBLIC WILL BE WISER"

"If these were made available by the middle of next year, a 17-inch set would cost upward from $500, while a 21-inch set would have to retail at anywhere from $600 to $800," he said. "Let's hope the public will be wiser this time."

A. V. Loughren, director of research for Hazeltine Electronics Corp. and vice chairman of the National Television System Committee, told a press conference in the Waldorf-Astoria that cost of initial color TV sets could easily be 2 or 3 times above current costs.

"And color sets will always retail higher than black-and-white sets," he added.

I wish to emphasize that in considering statements such as these, it will not be the cost of the Lawrence tube which I will subsequently describe which creates the prospect of excessive prices. I also wish to point out that high prices will make dubious the rapid advent of color.

THE LAWRENCE TUBE

Prior to Chromatic's advent into this field, one of the principal obstacles to commercial color television had been the lack of a practical, effective, and economical tube which would permit the showing of color teelvision pictures in the home.

As we emphasized in 1950 in the statement to the FCC, which I have previously referred to, our objective was to obtain a color picture of sufficient brightness that would be usable under all reasonable conditions. This we believe is a critical problem with respect to practical color television today. While controversy may and doubtless will continue over transmission standards, the tube—Chromatic's basic concern—is to any system what an engine is to the automobile. The tube is what is viewed in the home. The tube is what the public sees and is the source from which it obtains its information and entertainment. In brief, the tube is the ultimate component in any television receiver.

We can state, without any reservation, that Chromatic has now succeeded in removing the technical and economic obstacles to the production of a universal color television tube. Chromatic laboratories can now make available to the public, through the television industry, a tricolor, direct-view color-picture tube which receives high quality black-and-white signals, and color on either the presently approved field sequential standards or the proposed NTSC compatible standards with facility and effectiveness.

LAWRENCE TUBE HAS BEEN SUCCESSFULLY DEMONSTRATED

We are not talking about a gleam in some scientist's eye, or a blueprint design, or just a laboratory model. We are referring to fully developed picture tubes that have been demonstrated successfully on both the present and proposed NTSC standards of color transmission. In recent months, representatives from practically all companies engaged in television set and tube manufacture have attended demonstrations of the tube. The overwhelming reaction of the industry to the tube has been one of admiration for the quality of its color, the brightness of its picture, and the simplicity of its design. Because of the simplicity of its design, the tube offers a unique opportunity for mass production within the means of the public—at once. It is also significant to note that the tube has consistently produced an excellent quality black and white picture from existing black and white transmissions.

We are delighted at the opportunity to show the tube to this committee, or any other governmental body, and let you judge for yourself the quality and practicability of the Lawrence tube by seeing it in actual operation. We welcome your decision to view the tube on April 15. You will see it demonstrated on both the present and proposed NTSC standards.

This committee may be interested in a brief description of the tube. The color picture is displayed on a flat glass viewing plate within the tube. I presume that most of you have pictures of the

tube. On this glass plate are narrow strips of phosphors which light up under an electron bombardment in the three primary colors—red, blue, and green. Close to this target, or viewing plate, is a grid of fine wires in an array close to and parallel to the phosphor strips. The wire grid functions as an electron lens to focus the electron beam to a very small spot and it also acts as a color-switching control. Conventional black and white television components are used to deflect the electron beam in the tube and paint the color picture on the screen.

We are completely convinced that we have developed the solutions to the important problems of cost, complexity and brightness of the color tube. Virtually every expert who has seen the Lawrence tube agrees that no other tube which they have seen either does or inherently could meet the standards of low cost and quality of picture, including size and brightness, produced by the Lawrence tube.

DESIGNS FOR 28-INCH TUBE

The present model of the Lawrence tube is a 22-inch tube. However, designs have already been completed for a 28-inch tube. What is significant is that the Lawrence tube from front to back is about the same length, or indeed a little shorter, than conventional black and white tubes of equal diameter. This means that present cabinets can be used for our tube. Competitive models, on the other hand, are substantially longer, which inevitably means bulkier receivers. This differential becomes increasingly larger as picture size increases. For example, a competitive 16-inch-diameter tube is 26 inches while the 22-inch-diameter Lawrence tube is 21 inches long.

One of the most noteworthy characteristics of the chromatic or the Lawrence tube, which is inherent in its concept, is that it is uniquely efficient in its utilization of the light-producing qualities of the electron beam. This means that approximately 85 percent of the electrons are used within the tube to excite the phosphors producing the color picture. As a result, we have achieved a brightness of the picture which has hitherto not even been approached by any other color tube under normal operating conditions suitable for the home. In contrast to the 85 percent efficiency of the Lawrence tube, competitive tubes have been able to produce only 15 percent efficiency—and this low efficiency apparently is inherent.

Various concepts considered prior to the Lawrence tube either did not provide a satisfactory picture or were so complex and costly as to preclude commercial acceptance. Dr. Lawrence's tube minimizes these problems, since the design of the tube can easily be integrated into existing manufacturing processes used by television picture-tube producers. The nature of the design makes possible manufacturing tolerances which provide sufficient latitude to assure ease of manufacture. It is our firm conviction that the Lawrence tube can be mass-produced and sold to set manufacturers for only about $25 to $35 more than the cost of a black and white tube of equal size.

Pilot production of the tube is under way at our west coast plant. As a direct result of our demonstration of the tube to the industry, many of the companies active in the color field have ordered tubes to aid them in their color work.

CHROMATIC TUBE IS COMPATIBLE

Members of the committee have expressed interest and concern over the complicated considerations of compatibility. I would like to point out that in October 1951, Chromatic had demonstrated a combination black and white and color television receiver using the Lawrence tube. Such a receiver built around field sequential and existing black and white standards would have been just as compatible as the one described last Tuesday. It would also have been less costly.

Should any confusion remain as to the differences between a compatible and incompatible color television system, it may be well to redefine the terms here. A compatible color television system is one which can be received on black and white sets now in the homes of the public, in black and white, without any modification of the receiver. An incompatible color television system is one which cannot be received by existing black and white sets, either in black and white or color, without modification of the receiver. Only a relatively simple modification, however, is necessary to convert an existing black and white set to one which will receive field sequential color or black and white on the Lawrence tube. It is an economic impossibility, however, to convert existing black and white receivers to receive the color transmission of the proposed NTSC compatible system.

It must be pointed out that there are two parts to a television receiver, the picture tube and the circuits. Only the circuits are concerned in considerations of compatibility. The Lawrence color tube is in itself a compatible device regardless of the system of color transmission. It will reproduce equally well color transmissions on the field sequential or NTSC compatible system, and existing black and white broadcasts.

CHROMATIC'S EXPERIENCE AT NPA

The interest of this committee has apparently resulted at long last in removing a serious obstacle to the development of color television. I refer to order M–90, issued by the National Production Authority on November 20, 1951. Most of the control orders, except on the allocation of basic and critical materials, have long since been rescinded. It appears that M–90 remained, whether through an oversight or design, I am unable to state. However, it was the position of Chromatic at that time, and it is our position today, that order M–90 was used primarily to stop color television in its tracks, and was not a conservation measure as its proponents insisted. As a matter of fact, this order was the only control measure limiting end-product that had been issued since World War II. At that particular time, the manufacturers of black and white receivers had heavy inventories.

About a month before M–90 was issued, Chromatic had made the first successful demonstration, of its tube to the public and other interested parties. The interest of those who witnessed this demonstration was very great. The press carried feature stories about this new development and Chromatic was besieged with numerous inquiries as to the status of its tube. There is no doubt that one result

of this widespread publicity was to raise hope in the minds of the consuming public that color television was immediately available.

The Electronics Branch of NPA called an industry conference in October of 1951. At that conference, Chromatic vigorously protested against stopping color television. We insisted there that manufacturers should be permitted to use the materials allocated to them in any manner they desired. We urged that if the necessities of mobilization required restrictions, they should apply to both black and white and color as well. In brief, it was our position then, as it is now, that the cloak of national defense should not be used for the purpose of protecting those who were unwilling to face the possibility of immediate color development.

An immediate consequence of this order was to require Chromatic to shut down a production plant in Stamford, Conn., because it was quite apparent that the effects of M–90 were to prohibit the manufacture and sale of color tubes and receivers even though no more critical materials would have been required.

M–90 was an unusual type of order at this critical stage in the development of color television. Chromatic felt and strongly asserted that the restrictive effect of the order was unnecessary and contrary to public policy. This position received little support from the industry. My only purpose in emphasizing Chromatic's opposition to this order is to suggest that the difficulties in the development of color television service to the public are sufficient in themselves. Artificial and unnecessary restraints by Government agencies can be fatal to the realization of an adequate service to the public. So could be the use of an inadequate tube in an otherwise well-designed set.

CHROMATIC TUBE AT THE CORONATION

We have just announced publicly that arrangements had been completed for a special color telecast of the British coronation ceremonies. Approximately a dozen color receivers will be installed in various public institutions in Britain, and each receiver will be equipped with a Lawrence tube for this historical occasion. We feel that these color broadcasts will constitute a significant landmark in the development of color television.

In conclusion, I wish to reiterate that the Lawrence tube has the performance characteristics that can bring a high quality color service into the American home. The unique factor of picture brightness which this tube alone has achieved under normal home conditions is like greatly increased horsepower in the engine of an automobile—its performance under all conditions is superior. Chromatic stands ready to make available to the American television industry this outstanding development of Dr. Lawrence and his colleagues. We are enthusiastic about color television and we are enthusiastic about our tube, and finally, we are optimistic that the constructive and impartial attitude of this committee in seeking to expedite solutions in this complex field could well mark the beginning of a real program of development for the benefit of the public whose interests you gentlemen represent.

I would like to ask permission to read a cablegram which I received from Dr. Lawrence, who had been invited to appear here today. It is addressed to me. It is from the steamship *A. N. Kemp* which I imagine is some place in the Mediterranean.

[Steamship *A. N. Kemp* via Mackay Radio]

AMAGANSETT, N. Y., *March 24, 1953.*

RICHARD HODGSON,
President, Chromatic Television,
New York City:

Thanks for cable relating to current developments in color television. Was interested to learn of the increased attention that is being given to color. With M90 rescinded every effort should be made toward final decision on color standards so that progress may be accelerated. Please express regrets to committee about inability to be present. Regards.

ERNEST LAWRENCE.

The CHAIRMAN. I had announced that I was in receipt of a telegram that advised me as to the inability of Dr. Lawrence to be present today. However, I stated that it would be our purpose to give Dr. Lawrence an opportunity to testify at a later date.

I am in receipt of a communication of H. B. McCoy, Acting Administrator, National Production Authority, which I think has particular relevancy at this point, in view of the fact that reference has just been made in the statement of the witness to the artificial arbitrary and unnecessary restraint by Government agencies and pointed out that such can be fatal.

I have before me a letter that is particularly gratifying, addressed to me as chairman of the committee. It reads:

DEPARTMENT OF COMMERCE,
NATIONAL PRODUCTION AUTHORITY,
Washington 25, March 26, 1953.

HON. CHARLES A. WOLVERTON,
Chairman, Committee on Interstate and Foreign Commerce,
House of Representatives, Washington, D. C.

DEAR CONGRESSMAN WOLVERTON: With further reference to your letter of March 17, 1953, and my reply dated March 20, 1953, NPA Order M-90 which dealt with the manufacture of color television for home use has been revoked. With this revocation, there are no restrictions under the Defense Production Act on the manufacture of color television receivers and equipment for home use.

The public notification of this revocation will appear in the Federal Register either today or tomorrow.

Sincerely yours,

H. B. MCCOY, *Acting Administrator.*

With that information before you, what if anything have you to say as to the possibility of color television in the near future?

Mr. HODGSON. Well, with M-90 order still standing, there was obviously no possibility of any widespread production or extensive development of color television being permitted.

I think in view of the statement of the witness yesterday that the only commercially approved standard, the field sequential standard, which is one that his company or other companies apparently are not interested in pushing at the present time, that we must look to the action of the Federal Communications Commission to examine proposals of the industry for a new compatible system and hope that this can be done expeditiously and that you certainly should have a decision which would permit the industry to move ahead rapidly by the end of this year.

I think in anticipation of the Commission taking up this question, the industry now has an opportunity to proceed with the winding up of what development work needs to be done on their own system.

The CHAIRMAN. In your opinion then the rescinding of this order very definitely advances the day at which the public can expect color television?

Mr. HODGSON. Absolutely.

The CHAIRMAN. With respect to your own company, if you are in a position to express its intentions, what will be the result so far as your company is concerned as a result of the rescinding of this order? I noted in your statement that when the order was made that it necessitated the closing of your factory at Stamford, Conn. Would it mean your factory would be opened, and your company would go into production?

Mr. HODGSON. That particular plant we not only closed, but moved out and transported our activities to the west coast.

What it does mean is that we can now move ahead and plan for production of color tubes without the fear that we will be restrained again, and this is what we intend to do.

The CHAIRMAN. Is there any further action in your opinion necessary by the FCC, to insure the possibility of your going ahead without being interrupted?

Mr. HODGSON. By the FCC?

The CHAIRMAN. By the FCC.

Mr. HODGSON. Well, I doubt that any action of the FCC would prohibit Chromatic as a tube manufacturer from going ahead with its program.

Our interest in what the FCC actions might be would be to accelerate the acceptance of standards for a system which would in itself create a demand for our product.

Chromatic has been concerned with a very small, but we feel an extremely important element in the overall color television system, which is the tube. The tube, however, is not a matter of regulation by the FCC, because it does not affect the system of transmission.

As I have stated in my memorandum here this morning, the tube will work equally well in any system which the FCC has considered. Our only interest is in getting color television going; getting it off the ground, so that there will be a demand for it and broadcasters will be in a position to know what they want to broadcast and in that way stimulate the requirement for color receivers.

The CHAIRMAN. What I am endeavoring to get answered is the suggestion that was contained in your answer a moment ago in which you said that if you were not further deterred. What did you mean by that?

Mr. HODGSON. Well, any small company such as Chromatic is, that has only a very particular and unique part of the overall color television system, could find itself frozen out perhaps because it could not supply the entire system; could not supply all of the components.

In other words, a manufacturer has to, a television set manufacturer, has to deal with two people. The FCC is not involved in this particular condition, but perhaps you gentlemen might be.

We do not want to see any condition develop in which the proponents of a color system or the industry generally would feel that it was obligated to buy whole package, so to speak.

The RCA describes a complete system, radio tubes, transmission system, picture tubes. The habit of the industry has been to buy a complete line.

We are coming into the picture without a complete line.

So, we think we have got one element in that line which is the most superior product there is. The only thing we feel could impair the successful development of the Chromatic Co. is resistence of the industry to depart from their policy of buying the complete package and ignoring the chromatic tube even though it does have many characteristics which make it a superior tube for the presentation of color television.

The CHAIRMAN. Now, we have crossed the first hurdle in that Order M–90 has been rescinded.

Mr. HODGSON. That is right.

The CHAIRMAN. You consider that beneficial?

Mr. HODGSON. Very beneficial.

The CHAIRMAN. Now, as to the next step, what do you think should be done or can be done by this committee or otherwise, to advance color television for the benefit of the public? What would be your next step by suggestion or otherwise to this committee?

Mr. HODGSON. Well, I think if I had that responsibility I would want to be sure that the results of this hearing and the information which you have obtained here does not just stop there. In other words, I am sure this will not happen, but this is my feeling, that this committee continue to take an active and aggressive interest in the advancement of color television; that it has obviously influenced the Commission's activities—it obviously has had an influence on the industry in general. We would not like to see the information and the evidence that has been presented here as to how close color television appears to be now merely put in a report some place and just forgotten about. We would like to see the thing actively carried on and kept in front of the public so that the public knows that there is a sincere position maintained that color television is available and it will become available.

The CHAIRMAN. Well, assuming that there is 100 percent sincerity on the part of this committee to advance the time when color television will be available to the public, what would you do, if you were a member of this committee, and had the full power to act?

Mr. HODGSON. I am not sure how far this committee can go.

The CHAIRMAN. Tell us what you would do, and I will then tell you whether we can do it. I will tell you whether we have the power to do it.

Mr. HODGSON. Well, this might be one suggestion: I think that before the industry compatible standards are accepted, they should be subject to a hearing by the FCC. I think it should go through the formal processes which color television, UHF and VHF, and the whole scheme of the industry has gone through during the transition stages. I do not believe that the standard should be accepted, except by doing that. But, what I think this committee could do is take the industry's statements which you may get tomorrow—I do not know what they will be, but the industry is going to conduct field tests, and are going to complete those tests, I understand in 4 months, and then they will be in a position to request the Commission to hold a hearing.

I would certainly put on my calendar 4 months from today that if the industry had not come to the Commission and requested that hearing, that this group should suggest to the Commission that it might be in the public interest to call a hearing on its own motion on color television.

The CHAIRMAN. I think the suggestion that you have made is one that would be within the rights of this committee.

Mr. HODGSON. I am glad to know that.

The CHAIRMAN. I am directing these questions to you, because you are the first witness that we have had the opportunity to make a direct appeal to along this line. You are the first witness who has appeared since Order M–90 has been rescinded. I would have liked to have had the same opportunity to present these same questions to the others who have preceded you, and maybe we will take the means to find out from them what can and should be done under these changed circumstances.

This committee is very anxious that the public should have color television. We are proceeding along the lines that we hope will produce results. We feel that we have accomplished something in seeing this Order M–90 rescinded.

Now, with respect to the hearing before the FCC. There has been advanced to us the viewpoint, with a brief that was filed 2 days ago, that the FCC would have the right to proceed on its own motion. If that be true—and I hope it is—it not only will be very gratifying to this committee to have the FCC take whatever action, if any, is necessary, at the earliest possible day and I am inclined to think—not assuming to speak for the committee, but believing that I can read their minds—that this committee will undoubtedly, in view of the present situation, request the FCC to take whatever action it may deem necessary to advance the possibility of color television to the public at the earliest possible day.

You spoke of a deterrent that might result from the industry being unwilling to take anything other than a full package, I think you described it that way.

What, if anything can this committee do with respect to requiring the industry to take a full package or even a part of a package? Is that a question of business, sales, or is it a question of law, or does it include a question of violation of law to prevent, in your opinion, a recognition of your product which you have classed as not a full package?

Mr. HODGSON. Well, you have seen an industry refuse to take up the field-sequential system for reasons which were considered engineering reasons.

I think if you gentlemen had seen the pictures that were available at the time the Commission made its decision, there would have been no question in your minds that it was the best color television available, in 1950 and 1951.

The CHAIRMAN. I do not think that the committee is called upon to express any opinion with respect to that.

Mr. HODGSON. After all, all the public is interested in, when they go down to a store and look over a color television receiver, they do not care too much about what is inside of it. They look at the picture and I think the Commission was completely justified in making the

decision that it made at that time, and yet you saw the industry boycotting it because of engineering considerations.

The industry had no reason to worry about compatibility. That was a broadcaster's problem. Yet, it was a broadcaster that proposed the field sequential standards.

You raised the question as to whether the pressures I am thinking about might be influenced on sales; whether they are legal problems, or illegal problems.

You are getting into an area which is a very complex one in the electronics business. It is sales; it is legal; it is licensing; it is cross-licensing—there are many areas there which the committee might be very interested in investigating.

As you probably know—I am not quite sure of the date—the Department of Justice raised the question as to whether or not there was any undue pressure or were any undue pressures which were preventing color television appearing because of licensing and patent arrangements. This investigation did not get off the ground. I do not know exactly where it stands at the present time; but I think there are areas in there which this committee might well wish to inquire into, to insure that there is nothing underway in the operations of this industry which would prohibit a small manufacturer from having an equal opportunity to compete in the market place, you might say.

The CHAIRMAN. Well, the point that I am trying to drive home is that there is a deep and sincere desire on the part of this committee to get results. We want to know what is stopping color television from being given to the public. If it is legal, we want to know it; if it is economic, we want to know it; if it is failure of Government agencies to act, we want to know it.

In other words, the field is wide open for the committee to get any kind of information that can be given to it that will assist it in bringing color television to the benefit of the public.

I cannot state it any broader than that. I think I have made it very, very plain, and I hope that those who testified before this committee will be equally frank and plain in what they have to say, and not assume that this committee knows more than it does with respect to any deterrences that there may have been hindering the progress of color television. There is no iron curtain here.

Mr. HODGSON. I am sure of that.

We have seen two things happen in color television, which I will attempt to outline here. One Dr. Stanton traced for you yesterday, the delays in acceptance of the standards his company advocated; the delays which came about, such as legal injunctions, prolonged court hearings. Then you came to M–90, which affected his company and it certainly affected our company.

The news which you gave us this morning that M–90 had been lifted, and the statement that Dr. Stanton made yesterday that his company does not plan to start broadcasting field sequential color at the moment, puts us in the position, the country and the Chromatic Co., and this committee, in the position of looking toward the industry for its system and the rapid acceptance of its system.

We have had very friendly acceptance and endorsement of Chromatic's tube in the demonstrations which we have had to date. We have every reason to believe that the industry likes the tube and they are going to use it. We just do not want to see anymore court orders

or anymore M–90's, or some unknown factor. We are not trying to hide. We just do not know. We just do not want to see something else happen which will prevent color television from coming or hurt Chromatic. That is my position in representing the company.

The CHAIRMAN. Is there any action necessary by the FCC in the fixing of standards to enable you to proceed with your product?

Mr. HODGSON. I do not believe directly there is.

As I stated before the tube is of a universal design, so that it is hard for me to conceive of a set of standards which the FCC could approve which would eliminate the use of the Lawrence tube; but indirectly, the FCC can help Chromatic. It can help the public by taking up this color question and taking it up quickly.

But, fortunately, we have a design which is flexible enough to fit in with any of the known standards, and unknown standards, I think, that could be suggested.

Mr. PRIEST. Mr. Chairman.

The CHAIRMAN. I think I have made it plain to you and to the public in general as to what the attitude of this committee is with reference to this subject; its purpose in calling these hearings; and its determination to see the matter through to a conclusion.

If at any time, today or the days that are ahead, upon further reflection you have any suggestions to make that you believe would be helpful to this committee in pursuing its objectives, I want you to feel the utmost freedom in presenting them to the committee.

Mr. HODGSON. I greatly appreciate that opportunity. It is good to have a friend in court, so to speak.

Mr. HINSHAW. Mr. Chairman.

The CHAIRMAN. Mr. Hinshaw.

Mr. HINSHAW. Mr. Hodgson, is that Paramount Pictures Co. that owns an interest in your company, the same Paramount Pictures that recently consolidated their television interest with ABC?

Mr. HODGSON. No, sir. There was a company called Paramount Pictures, Inc., which was dissolved into a producing company and a theater company. The producing company is Paramount Pictures Corp. and is the one which has an interest in Chromatic. The theater company, the one known as the United Paramount Theaters is the one that recently acquired the American Broadcasting Co.

There is no financial relationship between the two companies at all.

Mr. HINSHAW. On page 10 of your statement you have made some statements that seem slightly confused. After discussing what a compatible television system is, you said:

> It is an economic impossibility, however, to convert existing black-and-white receivers to receive the color transmissions of the proposed NTSC compatible system.

Now, do I understand then that you cannot convert, or it is economically impossible to convert these receivers to receive the color transmission, but that they can be converted to receive color in black and white?

Mr. HODGSON. That is correct. Maybe I should add that they can only receive color transmissions in black and white.

Mr. HINSHAW. Well now with your tube, I understand that the existing sets can be modified at a very low cost, according to your statement, to receive color television on the field sequential system; is that correct?

Mr. HODGSON. That is correct.

Mr. HINSHAW. Can it, can that tube also be used in a similar manner in modification of the existing sets to receive the NTSC standard broadcast?

Mr. HODGSON. The tube could be used, but the cost, as I tried to point out further down, that the things that would have to be converted in a television receiver to take care of the compatible problems, to make it a compatible receiver, out of an incompatible receiver, involves only the circuits.

I think it was testified here on Tuesday that even the proponents of the NTSC system recognize that it is uneconomical to convert existing black and white receivers to receive color; but the considerations lie only with the circuits—the resistors and the transformers, and the capacitors in receivers. They do not lie with the picture tube.

Mr. HINSHAW. Let me ask you——

Mr. HODGSON. If I may continue with the answer to your question, you could use the Lawrence tube to convert or as part of the conversion in existing black and white receivers to receive the NTSC compatible standards, and the cost of that tube would be no greater in that case that it would be in the case of a converted black and white receiver to receive the field sequential standards, but the cost of the circuit modifications in converting to receive color in the compatible standards would be exceedingly high, as was testified to here by people who know; probably be higher than the cost of the initial set.

Mr. HINSHAW. There would not be any advantage in that.

Now, what do you think it would cost to convert the existing receivers into color receivers for the field sequential system? What would be the range in probable costs?

Mr. HODGSON. Well, we feel that the tube, 21 inch, or 22 inch tube under mass production cost conditions will probably $60 or $70.

You have heard testimony from the witness yesterday, out of the presentation before the FCC, that the cost of the adapter, which is a circuit modification to make existing receivers color receivers of the field sequential system would run around $30. So, you have got the total cost there of something under $100 to convert most existing receivers to receive color and black and white from the field sequential standards. He also added, however—I think that the record will bear this out—but I think if you were to build as was mentioned here, build it at the factory, build a new receiver, which would receive color on the field sequential standards and black and white on the black and white standards, and use a dircet view tube, that the cost of that complete receiver would not be much in excess of a black and white receiver.

Mr. HINSHAW. Now, I take it that your tube can be used in the NTSC standard receiver when built new?

Mr. HODGSON. That is right.

Mr. HINSHAW. Do you see any reason why the cost of a new set to receive both black and white and color on the NTSC standards should be double the present cost?

Mr. HODGSON. Initially, it might. I think you can expect those costs to come down where it is not going to be double.

Mr. HINSHAW. How much more should it cost under the NTSC standards to produce a receiver that will receive both color and black and white?

Mr. HODGSON. Well, we have not made a detailed investigation of the circuit costs, to make an NTSC receiver. It is known that if the receiver has maybe a third more receiving tubes in it than the black and white set, and the rule-of-thumb cost in the television receiver industry would indicate that maybe that is going to run or make the receiver cost the company making it a third more than the black and white set. The color tube is going to cost thirty or thirty-five dollars more than a black and white tube. So, you would end up with a final cost under conditions where production has settled down, where you should be able to build a compatible receiver for less than twice the cost of a black and white receiver. Now, you are not going to do this initially. You may absorb the costs. The receiver manufacturers may want to get the units out, but you are not going to make much money on it. I think this is a thing that we will have to realize in the NTSC compatible system, that it is involved, because it makes fuller use of the frequency channels that are available for color, black and white, and involves more critical standards. I mean, more close tolerances in the design of the receiver; just as the television receivers requires closer tolerances than AM radio and FM requires closer tolerances than the AM radio. You are going to higher standards and a higher development status of the art, and the costs are going to be higher, necessarily.

There are many development in the electronics industry which could reduce the cost of the color television receivers in the future. We will have the transisters and we will have many other things which today are costing a lot of money, but we all hope that those costs are going to come down and that the public will be able to purchase a color television set, receivers, and that they will cost little more or maybe not anymore than the black and white sets of today, 7 years from today, just as black and white has come down in that same period; but you are talking about a higher, more complex receiver than you are talking about today and it is going to cost more.

Mr. HINSHAW. I gather from your testimony then that it will cost less to the public for a receiver to receive black and white and color under the field sequential system than for a receiver to receive black and white and color under the NTSC system?

Mr. HODGSON. That is my feeling; yes, sir.

Mr. HINSHAW. By how much—percentagewise or otherwise?

Mr. HODGSON. How much?

Mr. HINSHAW. I am talking about a field sequential receiver.

Mr. HODGSON. Yes; I understand. Well I think that taking the tube out of the situation, because it is common to each receiver—we are talking about the circuit cost now—that where you might say an NTSC color receiver may cost a third more than the black and white set, that a combination field sequential and black and white receiver might cost—I am really estimating now—15 percent or 20 percent more.

Mr. HINSHAW. It would be considerably cheaper?

Mr. HODGSON. Naturally it would be; yes.

Mr. HINSHAW. Is there any new type of antenna required for a color TV, other than that now required for TV?

Mr. HODGSON. No.

Mr. HINSHAW. There is not?

Mr. HODGSON. No.

Mr. HINSHAW. Well, I hope that this is not considered a facetious remark, but if you have the best color television tube, I do not see what you are worrying about, unless it has something to do with the machinations in the industry. The public will finally decide which is the best tube, will they not—or will they not get that chance?

Mr. HODGSON. Well, it is only if they do not get that chance that the Chromatic Co. could be hurt.

Mr. HINSHAW. What could stop them from getting that chance?

Mr. HODGSON. Well, I have seen situations in this industry where a receiver manufacturer has at rather great cost acquired and developed a cathode-ray manufacturing plant so as to have its own source of supply of picture tubes. It normally had been buying them elsewhere in the industry. It suddenly found that when there was a shortage of receiving tubes, it could only buy receiving tubes, get the deliveries it wanted, if it also agreed to buy picture tubes from the same source. So, it cut down the operational efficiency of its own picture tube plant to buy, perhaps at higher prices, picture tubes in order to get receiver tubes, in order to sell its receivers.

Now, you may say that is just what happens in free enterprise.

But, those are the kinds of pressures which worry Chromatic, which has only got a picture tube. We are not contemplating going into the receiving tube business. We are not contemplating that.

Mr. HINSHAW. In other words, that is the old package deal.

Mr. HODGSON. That is right. That is the problem.

Mr. HINSHAW. That is all, Mr. Chairman.

Mr. PRIEST. Mr. Chairman.

The CHAIRMAN. Mr. Priest.

Mr. PRIEST. Mr. Hodgson, I think the Chairman and Mr. Hinshaw have asked most of the questions that I have made notes on. I wish, however, to focus for a moment on a question that the Chairman pursued with reference to the next step. It would seem to me now that the FCC, having approved the field sequential system and with order M–90 having now been revoked, that the next step of any consequence should be a step by the FCC.

Now, the FCC may do about 3 things, if I understand the act fully. They may, on their own motion modify the previous order. They may, on their own motion call a hearing. Or they may wait for the industry to petition for a hearing. I think those are possibly the three choices or opportunities for the FCC.

Now, I understood in your testimony that you felt that the order should not be modified without a hearing; is that correct? You feel there should be a hearing before any further order establishing standards for color television broadcasting is issued?

Mr. HODGSON. Yes, I feel that there should be a hearing.

Mr. PRIEST. Well, I agree with you there. I think it would be unwise to modify the order, as you expressed it, on an arbitrary or dogmatic basis, without a further hearing. It would seem to me then that the best recommendations that can come out of our consideration here would be a recommendation to the FCC that on its own motion at a very early date, it set a hearing and call the industry in for that hearing. I am assuming in making that suggestion to you, for your opinion on it, that the industry is ready for a hearing. Is that true, in your opinion? Is the industry ready at this time to go before the FCC again with its recommendations on standards?

Mr. HODGSON. Well, as I understand the FCC's own feeling about this is reflected in the statement they made at the time the field sequential standard decision was made, that they would only be willing—this is my impression—that they would only be willing to consider a new system after it had been adequately field tested.

I would presume that Dr. Baker tomorrow will give you some information on the status of the field testing of the industry system; but by the NTCS' own schedule, their field testing is probably going to run for another 3 months. Now, taken on its face value, 3 months from now, it might be appropriate, if the industry does not come to the Commission, as I suggested to the chairman, to, on its own motion, start the hearing; but I feel, in fairness to the Commission and in the interest of conserving time in hearings in looking at a system which might not be completely field tested, that the industry should have an opportunity to complete its field tests on the schedule which it has set up.

Mr. PRIEST. I agree that that is proper. I think that it should be field tested before a new hearing is held.

Now, just one other question, Mr. Hodgson. On page 9 of your statement you say:

> In contrast to the 85 percent efficiency of the Lawrence tube, competitive tubes have been able to produce only 15 percent efficiency.

Now, the question in my mind is what is the basis of this efficiency percentage? It would seem that 85 percent as contrasted with 15 percent is a pretty wide disparity in percentage of efficiency, and I want a little more information as to the basis of those percentages. Efficiency in what?

Mr. HODGSON. In color brightness of the tube.

The tube which Dr. Lawrence conceived has inside of it, as you can see by looking at that picture, a viewing plate on which color phosphors are deposited. Closely spaced behind it is a grid of wires which are spaced apart 20 mils. Those wires are of a very small diameter and if you were to take this grid up and look at it, you would find, or if you calculated it out, that the wires presented a shield between the phosphorus screen, which is the thing that is excited on which you view the picture, and the electron gun, which is the source of the electrons.

Now, the amount of shielding that is done by the wires is around 15 percent, and this is assuming that all of the electrons that went into those wires do not go through to hit the phosphorus screen. Fifteen percent of them will hit the wires. We believe maybe they do not all hit the wires. They may go around them. But, that is something else.

Other designs of tubes, in order to obtain registration, the electron gun beams from those guns to the tube, have placed a mask between the gun or guns and the screen and this mask which serves a different function than the wire grid of Dr. Lawrence's tube, will intersect about 85 percent of the electrons, and it is on that basis I have made the statement here that one tube has an 85 percent efficiency the other one has a 15 percent. It is based on the number of electrons that hit the screen.

Mr. PRIEST. Well, that wide range between the two in percentages of efficiency interested me a great deal.

Now, just one further question. Was the Lawrence tube available at the time the FCC made its decision and gave its approval to the field sequential system?

Mr. HODGSON. Unfortunately Dr. Lawrence had not thought about it to the point where he had built tubes. He had been thinking this problem over for a great many years, but only had early models at that time and we did not feel we should participate actively in the hearings, since it was a system hearing.

The Commission considered the tube and there is reference in the testimony about this fact that there was such a tube under development.

Mr. PRIEST. That is all, Mr. Chairman.

Mr. O'HARA. Mr. Chairman.

The CHAIRMAN. Mr. O'Hara.

Mr. O'HARA. Mr. Hodgson, do you feel that the delay which ensued since the Commission's order on the field sequential system has actually been a good thing in some respects in the development of certain phases of the color television? I mean the fact that it did not go into actual operation for several reasons? For example you indicated in your last answer that the Lawrence tube has been developed since then which you claim is highly beneficial; is that correct?

Mr. HODGSON. The fact that you have a good tube is beneficial; yes.

Mr. O'HARA. That is beneficial.

Mr. HODGSON. That is not my answer to your question, though.

Mr. O'HARA. Well, I want you to answer it.

Mr. HODGSON. I do not think that the delay has been beneficial at all, I mean to the public. Assuming the public wanted color television, delaying it 3 or 4 years certainly has not been beneficial.

Mr. O'HARA. I did not mean it that way. I am as anxious to get color television as anyone else; but the point that I am making was in the realm of uncertainty existing at the time the Commission made its order on the field sequential system. You say in your testimony that the Commission decision was justifiable, that it was a justifiable order at that time and that you felt that it was the only one that they could make. But the point that I am making is that since that time, the people who have been working in the industry and have been working on this problem, have made advances. Is that correct?

Mr. HODGSON. Well yes, the compatible system techniques have improved greatly since that time. There is no question about that. The system being considered today is a much more refined and improved compatible system than the dot sequential system that was being advocated at the time of the hearings. However, technological improvement is something that is going on all of the time. Now, this was very much in issue and at point during the hearing: Should you wait for the best or should you take something that is very good now? At what point will you make this cutoff and accept standards?

I do not think that I can say that you should wait for the ultimate decision. I do not think that the NTSC system at the moment is the best system that could ever be developed, given time. I think the Commission is going to have to decide on the basis of the field tests, whether it is adequate for the purpose to be used.

Mr. O'HARA. Now, because of the NPA Order No. M–90, do you think the field testing and development by the industry has been seriously retarded?

Mr. HODGSON. Well, by their statements that they had no engineering activity on color television, could not afford to do it because of the manpower shortage, I can only assume that it was retarded.

Mr. O'HARA. Did order M–90 restrict the manufacture of black and white television?

Mr. HODGSON. Not at all. That was our objection to it.

Mr. O'HARA. The same material is used in black and white as would have been used in color?

Mr. HODGSON. That is correct. As the gentleman here yesterday or the day before mentioned, copper is used in color. It is used in black and white.

Mr. O'HARA. What was the justification for Order No. M–90?

Mr. HODGSON. We felt there was no justification for it at any time under any conditions, the way it was written.

Mr. O'HARA. Now, if I get your testimony correctly—if I do not state it correctly, please correct me—as I understand witnesses who have testified during the past 2 days, and you testify, that the actual adoption of color television is not going to come by putting new tubes into old sets, and new adapters and that sort of thing into old sets, but that the public is going to be ultimately forced to buy a color television set. Is that a fair statement?

Mr. HODGSON. That is right.

Mr. O'HARA. As a practical, economic matter?

Mr. HODGSON. At the present time. That was not true at the time the field sequential standards were accepted. I think that there were people who would have been willing to convert their receivers. It has always been an unpopular thing. But at least, you had an opportunity to convert your receiver to receive color. Today I do not think there is any question about it. People will not convert their sets to a compatible system, because of the cost and so forth.

Mr. O'HARA. Now, will the new color television sets that will be developed, will they be able to take black and white without any extra equipment and without any extra cost to the public? I mean, let us look ahead 2 or 3 years, and I buy a color television set that will play color television; will it also play black and white?

Mr. HODGSON. Yes; it will.

Mr. O'HARA. That will be 1 machine; I will not have to have 2 machines.

Mr. HODGSON. One machine and one tube.

Mr. O'HARA. Now, as a practical thing, there is another thing that bothers me. I like to watch football games on television. On a rainy day, with a color-television apparatus out there taking the plays of the game, is the color television much good to you in the rain?

Mr. HODGSON. Well, what does your eye see on a rainy day out at the game? You can still see the colored jerseys. The grass is still green, and the color does not disappear with the rain. It is going to be a gray day.

Color television will bring things to you in a natural way. That is one of its greatest advantages.

Mr. O'HARA. Now, I think it has been testified to that there are about 23,000,000 television sets in operation in our country now. I presume by the time this industry develops a color television there probably will be 25,000,000 or maybe more. Is that an unusual estimate?

Mr. HODGSON. I have not seen any estimate as to what the industry feels the black-and-white ownership will be by say the middle of next year; but it can be expected to grow somewhat. We gather from the statements by some representatives of the industry, that they are concerned as to what the public will now do as to buying black-and-white sets, if they think colored sets are around the corner. So, I think than an estimate as to what number of black-and-white sets will be in use a year from now is subject to a fair amount of difference.

Mr. O'HARA. Did you see the motion picture, the Quiet Man?

Mr. HODGSON. No; I did not.

Mr. O'HARA. Well I thought it was an excellent example of color photography.

Does color television bring out in detail the colors to the same extent that the photograph camera brings it out in colored motion pictures?

Mr. HODGSON. Well, I think there is more detail in the motion-picture film than can be transmitted over the television system.

Mr. O'HARA. Will you repeat that again?

Mr. HODGSON. I think there is more detail in a motion picture, 35-millimeter motion-picture film than it is possible to transmit over black or color television channels. However, I have seen Technicolor motion pictures transmitted over the color-television system, using the compatible standards, and the results are highly enjoyable. It is a favorable reproduction of the color-photographic process.

Mr. O'HARA. That is all, Mr. Chairman.

Mr. ROGERS. Mr. Chairman.

Mr. HINSHAW. May I interrupt for a question? Will you yield?

Mr. ROGERS. Yes.

Mr. HINSHAW. I would like to ask whether it is intended by the broadcasters—and of course you cannot answer this question for the broadcasters, to broadcast color on the existing 12 channels, or to confine it to only UHF?

Mr. HODGSON. I am not a broadcaster, but I think I could answer that. The fact that your station is on a VHF channel does not preclude you from transmitting color on that same channel. I presume in starting out that they might transmit 5 or 6 hours on a station, of color, on the same channel, and then maybe the rest of their programs in black and white on the same channel. You can use the UHF and VHF, same channels, in transmitting color or black and white. It simply depends upon what channel you are broadcasting upon, and what channels have been allocated for you to use.

Mr. HINSHAW. What I am trying to get at is we have the present television sets designed for the existing 12 channels.

Mr. HODGSON. Yes.

Mr. HINSHAW. And without modification, that is all there is to it.

Mr. HODGSON. Yes, sir.

Mr. HINSHAW. Now, will color be broadcast on those 12 channels?

Mr. HODGSON. Absolutely; yes.

Mr. HINSHAW. And can be received?

Mr. HODGSON. Yes.

Mr. HINSHAW. And in black and white, received by the existing receivers?

Mr. HODGSON. Yes.

Mr. HINSHAW. Without modification?

Mr. HODGSON. Yes.

Mr. HINSHAW. But if the field sequential system is adopted, a slight modification can be made to receive color on those channels without building a new set?

Mr. HODGSON. That is right, but that is not related to the frequency, or the channel over which the signal is being broadcast. In other words, you have got five VHF channels here in Washington, I believe. Those channels can be used.

Mr. HINSHAW. I would not know, because my receiver will not get them.

Mr. HODGSON. Well, take Pasadena then. You have seven channels available to you there. I know this is true, because Paramount has one of those channels. On those seven channels you will be able to receive color, and black and white on the same channel. You will receive color when color is being broadcast on that channel, and black and white when black and white is being broadcast on that channel.

Mr. HINSHAW. With the NTSC system, or with that system, I would not require any modification to receive a color broadcast, in black and white; is that correct?

Mr. HODGSON. That is correct.

Mr. HINSHAW. That is all.

The CHAIRMAN. Mr. Rogers.

Mr. ROGERS. Mr. Hodgson, I believe yesterday Mr. Stanton stated that there were some 23,000,000 television sets in use now?

Mr. HODGSON. 23,000,000.

Mr. ROGERS. 23,000,000?

Mr. HODGSON. Yes.

Mr. ROGERS. Now, with the development of this Lawrence tube, with the use of the Lawrence tube they can be used to obtain color television; is that right?

Mr. HODGSON. This gets back to this same problem of converting a receiver to receive color.

The Lawrence tube can receive color on either of the two color standards that have been under discussion here this week or black and white. All it needs is the appropriate circuits to go with it in order to, let us say, decode the signal and apply the right color at the right time to the tube.

Now, these 23,000,000 receivers, if the industry compatible system supplants the present field sequential system for color transmission, it would be my guess that none of those receivers will be converted to receive color from the compatible system, because of the cost. That is, the cost of the changing of the circuits, that have to be changed; not the cost of the color tube.

If the compatible system is not, does not supplant the field sequential color and the field sequential color continues to be or becomes the standard of transmitting color in this country and the broadcasters begin the use of it, which they have not done up to the moment, then it is, I think, proper to assume that there would be a percentage of those receivers converted to receive color and black and white, because the cost would not be excessive.

Mr. ROGERS. What is the cost of the conversion?

Mr. HODGSON. Well, I think it was testified earlier that it would probably be under a hundred dollars. So, if you had gone out and purchased last week a $500 black-and-white television receiver, you probably would give great consideration to putting another hundred dollars into that receiver so that you could receive color and black and white. I doubt if you would go out and put another $500 into a receiver to receive color, from the compatible system, if it supplanted the field sequential system.

Mr. ROGERS. Now, I have this one other question. Do you have any observations to make as to your opinion as to why the NPA passed M–90?

Mr. HODGSON. All we got was a telegram.

Mr. ROGERS. Well now, at that particular time the manufacturers of black-and-white receivers had heavy inventories, did they not? What I mean to ask is could there have been outside influence brought to bear on the NPA which would have caused them to pass the sort of an order they did, by virtue of this high inventory?

Mr. HODGSON. I was going to say—I mean, there is always influence on Government bodies.

Mr. ROGERS. Was an opportunity given for a full hearing before M–90 was adopted?

Mr. HODGSON. Well, everyone was called down and given a chance to present his statement as to whether they were in favor of or against M–90. As I stated here, Chromatic was definitely opposed to the M–90 order. Other companies felt that it was not necessary. But in the end, the consensus of the industry supported the M–90 order.

Mr. ROGERS. Would it be your opinion that if the M–90 order had not been passed, we would have color television now?

Mr. HODGSON. I think it is clear.

Mr. YOUNGER. Will the gentleman yield there?

Mr. ROGERS. Yes.

Mr. YOUNGER. Would it be possible to put into the record at this time, or at this place, the names of the companies that appeared before the NPA and their statements, as to whether it should or should not be issued? I think it ought to go into the record at this point.

The CHAIRMAN. I can appreciate the importance of having the names in the record. Whether their statements before the Authority should go into the record, is something else.

Mr. YOUNGER. Just an indication as to whether they were for or against it.

The CHAIRMAN. Whether their entire statements should go in, I do not know. That would involve a question of printing.

Mr. YOUNGER. I just want the record to show whether they were for or against it.

The CHAIRMAN. Yes, I think that is very pertinent.

Mr. HODGSON. I do not have those names here.

The CHAIRMAN. I think they can be obtained.

Mr. HODGSON. They can be obtained from the NPA.

The CHAIRMAN. The clerk will make a note of the request of the gentleman from California (Mr. Younger) and communicate with the NPA and obtain the information that he desires, so that it may be put into the record at this point.

(The data referred to will be placed in the committee files.)

Mr. ROGERS. Mr. Hodgson, you did not appear before the Authority and your company did not appeal?

Mr. HODGSON. I beg your pardon.

Mr. ROGERS. I say you nor your company did not appear before the NPA protesting this Order M–90?

Mr. HODGSON. We protested it; oh, yes. We appeared.

Mr. ROGERS. You did?

Mr. HODGSON. We had an opportunity to appear.

Mr. ROGERS. That is all.

Mr. HESELTON. Will the gentleman yield at that point?

Mr. ROGERS. Yes.

Mr. HESELTON. Do you know what the relative position is today in terms of the inventories for black and white receivers?

Mr. HODGSON. No, sir.

Mr. HESELTON. As contrasted with the time that M–90 was issued?

Mr. HODGSON. No; I do not.

The CHAIRMAN. Mr. Hale.

Mr. HALE. Mr. Hodgson, you do not envisage any time when color television will supersede black and white completely?

Mr. HODGSON. Well, I would like to quote a comment on that which is probably more complete than I could give you here, William Lawrence of the New York Times. I heard his comments recently after he had seen color television. He said that they could never keep them down on the farm after they had seen Paree.

Now, whether this means that it never will be——

Mr. HALE. I suppose that another analogy is that the talkies drove the old-fashioned silent movies out of business.

Mr. HODGSON. Yes; but color did not drive the black and white motion pictures out of business. They are becoming a more dominant factor.

Mr. HALE. They have not yet, but they well may.

Mr. HODGESON. No. I think by now—I am talking in a field which I merely have opinions—but I think there are programs which are better suited to black and white treatment from the broadcasting point of view than they are color. I think a suspense show is one. I think it achieves a tone in an atmosphere in black and white which may be better than color. I think you will see obviously a balance established in there and it may be heavier on color than on black and white, but I do not think black and white broadcasts will disappear completely for a long time.

Mr. HALE. Many of us like to listen to recorded music and in the old days we bought record players with 78 r. p. m. for 78 r. p. m. records. The long-playing record, which is certainly an improvement in the art came and we all had to replace our equipment completely or buy an auxiliary set. Of course everybody today who buys a record player at all buys a record player that you might call a compatible player.

Now, is the adjustment which the present owner of a TV set is going to have to make more important, percentagewise, than the adjustment which the owner of a 78 r. p. m. record player had to make? Have I made myself clear?

Mr. HODGSON. Well, I think the difference in impact between the color program and the black and white program appeals on a much broader basis. I mean to a great many more people than the difference

between 78 r. p. m. and the high fidelity that you may get from long playing records.

Mr. HALE. In each case you are obsolescing old equipment.

Mr. HODGSON. Yes; but the obsolescence in the change of those standards I think was more important in terms of the record library which you may have had, rather than the cost of the turntable. You can buy a 3-speed turntable today for $35.

Mr. HALE. You refer to the obsolescence of your records, as well as to that of your turntable.

Mr. HODGSON. That is what hurt. I mean you are considering it from that point of view and why there would be the demand for the 3-speed record player.

Mr. HALE. I believe you said in reply to Mr. Hinshaw's question, that assuming you had a $500 black and white receiver, you would be willing to spend another hundred dollars to make it adaptable to receive color.

Mr. HODGSON. On field, assuming that the field sequential color standards were used; yes.

Mr. HALE. Something like 20 percent additional added to the cost of the set.

Mr. HODGSON. Yes.

Mr. HALE. That is all.

Mr. THORNBERRY. Mr. Chairman.

The CHAIRMAN. Mr. Thornberry.

Mr. THORNBERRY. I do not want to belabor this point about how you feel about the FCC approval of the standards for the sequential system; but let me ask you this: I believe you testified that you felt that the FCC was justified in accepting the standards for the field sequential system, which I believe it did in the fall of 1950?

Mr. HODGSON. Yes. We first recommended to the FCC holding in abeyance for a short period of time its decision, but if they could not do that, and they were judging the system on the basis of what they observed, that they had no choice except to take the field sequential system.

Mr. THORNBERRY. So you felt at the time that they were justified in reaching the decision that they did?

Mr. HODGSON. Yes.

Mr. THORNBERRY. Now, I believe in answer to Mr. O'Hara, who asked you the question as to whether you thought that the delay which had occurred since that time had been beneficial or not, I believe you testified you did not think that the delay had been beneficial.

Mr. HODGSON. Well, I take it from two points. As to the public I do not think it has been beneficial. The other point is you can always expect technological improvements, when given enough time. I think that there might have been much more rapid technological development of the compatible system if the M–90 order had not been issued.

Mr. THORNBERRY. Now, taking into account the delay which was caused—and I believe that you stated that it was resisted by the industry, and that delay was caused by the M–90 order, and court procedure, and I believe that at the time the FCC approved the standard of the field sequential system that there were around 2 million receiving sets in existence.

However, whatever the reason for the delay that has been encountered, there has been a tremendous cost to the public because of the delay.

Mr. HODGSON. Cost to the public?

Mr. THORNBERRY. Yes.

Mr. HODGSON. Well, from the point of view of color, yes.

Mr. THORNBERRY. I am talking about the owners of television receiving sets. Now, when you take into consideration that you now have owners of 23 million sets or more, we have to recognize that color television is going to have a tremendous impact on them.

Mr. HODGSON. Yes; I think in fairness, however, you must realize that the owners of those sets have been getting enjoyment from their black-and-white sets. They would have gotten more enjoyment from their money if they had had an opportunity to receive color programs instead of just black and white.

Mr. THORNBERRY. Well, I think that is true. I think that there are a lot of things that you have to take into consideration. But, as I understand your testimony, you think if it had not been for M–90, and the delays incident to that, or whatever other delays there were, we could have had color television sets all that period, from 1950, plus the benefit of any technological development during that period, and now, instead of having 23 million people or owners of 23 million black-and-white sets who are going to be faced within a short period of time with the fact that their sets are not equipped to receive color television, many of them would have purchased sets which were equipped for color.

Mr. HODGSON. That is right.

Mr. THORNBERRY. And I think you have testified that from your knowledge of equipment, receiving sets, that the cost to adapt those sets to receive color—some you said could be adapted at a slight cost to receive color broadcasts in black and white, and that it would cost relatively higher to convert them to receive color while new sets could be equipped by a very slight increase in cost to receive color. Is that correct? So that there is an increased cost or expense to the public as a result of that delay. Is that correct?

Mr. HODGSON. That is right.

Mr. THORNBERRY. That is all, Mr. Chairman.

Mr. DOLLIVER. Mr. Chairman.

The CHAIRMAN. Mr. Dolliver.

Mr. DOLLIVER. I just want to inquire about your licensing of your tube. You have stated that it is a greatly improved tube. Do you expect to license other manufacturers to manufacture it?

Mr. HODGSON. We have already entered into discussions with some companies leading toward the granting of licenses for the manufacture of the tube.

Mr. DOLLIVER. In other words, there is no disposition on your part to exercise your patent rights to restrict its manufacture to yourself alone?

Mr. HODGSON. We will benefit, obviously, by the widest use of the tube.

Mr. DOLLIVER. I just want to clear that point.

That is all.

Mr. HESELTON. Mr. Chairman.

The CHAIRMAN. Mr. Heselton.

Mr. HESELTON. I am reading from your statement:

We have just announced publicly that arrangements had been completed for a special color telecast of the British coronation ceremonies.

Is there anything different about the situation in England as compared with the situation here? Have they gone forward with color television further than we have?

Mr. HODGSON. You say have they gone further?

Mr. HESELTON. Yes.

Mr. HODGSON. Well, I think that the situation was fairly covered yesterday. England has no color television.

Mr. HESELTON. England what?

Mr. HODGSON. England does not have a color television service at this time either. The BBC, because of its relationship to the broadcasting industry—I mean it is the broadcasting industry in England—has been only interested up to this time, so far as I know, in pushing and expanding black-and-white television to England. I think up until a few years ago it was limited, to black and white, and television was limited to the London area. It is only recently that black-and-white coverage has been extended to other parts of Great Britain. Undoubtedly they will have color at some time.

We discussed our program with the BBC several months ago, to the effect that we felt that the colorful proceedings of the coronation provided an excellent opportunity to make color televisions showings in England, using the Lawrence tube. They were very receptive to this and although they are not sponsoring it, we have their blessings. This is something that they are interested in seeing.

Mr. HESELTON. How are they going to receive it?

Mr. HODGSON. I beg your pardon.

Mr. HESELTON. How will they receive color?

Mr. HODGSON. This will be transmitted from portable equipment, probably a small limited broadcast, in the London area. Transmitters will be operated by the company with whom we are participating in this effort, an English company, the Pye, Ltd. They will handle the transmission. Chromatic will provide the color tubes.

Mr. HESELTON. Is it fair to say that England is no further ahead than we are as far as color television is concerned?

Mr. HODGSON. No; I would say they are not as far ahead. I do not think much attention has been given to the color program.

Mr. HESELTON. What about the situation anywhere else—Canada, for instance?

Mr. HODGSON. Canada I think has shown in its past history, has tended to follow the standards and cooperate with the United States industry in setting up its standards. It is not as far along, as far as its coverage of population by television service is concerned as we are in this country. I think you can expect Canada will follow and accept the same color standards that are accepted here.

Mr. HESELTON. That is all, Mr. Chairman.

Mr. SPRINGER. Mr. Chairman.

The CHAIRMAN. Mr. Springer.

Mr. SPRINGER. Is——

The CHAIRMAN. Mr. Springer, pardon me, if you will. I want to announce, my information is that the work of the House is not im-

portant this afternoon and will only last a few minutes. Under the circumstances we will continue this hearing at 2 o'clock this afternoon, when we have finished with this witness. Dr. DuMont will be the witness this afternoon. I assume that the members of the committee will be very anxious to be present to hear him. He is an outstanding authority.

We will proceed with Mr. Hodgson until he completes his testimony so that we can start with Dr. Du Mont at 2 o'clock.

Mr. SPRINGER. Mr. Hodgson, I have heard varying testimony here—at least it does not seem to be very well settled. No one has been willing to present a very close figure.

Is it your estimate that it is going to take $100 in order to make the present black-and-white set ready to receive color?

Mr. HODGSON. Under the field-sequential system and standards.

Mr. SPRINGER. Under the compatible.

Mr. HODGSON. No. My statement is that it is economically impossible to take the present black-and-white set and make it receive color on the compatible standards.

Mr. SPRINGER. It cannot be done?

Mr. HODGSON. It can be done. It will cost too much. I mean, it would cost probably as much as the set cost in the first place.

Mr. SPRINGER. Under the field-sequential system, how much would it cost?

Mr. HODGSON. My estimate is that the cost would be about $100, or less than $100.

Mr. SPRINGER. What would be the major difference between making that transition under the field-sequential system and the compatible system? What is the difference?

Mr. HODGSON. Well, the difference lays in the complexity of the circuit changes that would be required in each instance. The circuit changes of a black-and-white set to permit it to receive color under the field-sequential standards are relatively simple. Hence the lower cost. The circuit changes required to receive a compatible color picture in color on black-and-white receivers—which you may have in your home—are so extensive that the cost I think you would find prohibitive. I mean—I think this was mentioned here before—you would prefer to take your black-and-white set and perhaps use it as a second set to receive these black-and-white programs, and buy a new receiver which would receive the color programs. It is technically possible, but it is just one of those things that you would not do. I do not think that you would take your car down and tear out the old gearshift system and have fluid drive put in. It is that kind of a situation. You would wait and buy a new car.

Mr. SPRINGER. Are you in the business of manufacturing sets?

Mr. HODGSON. Now, no; we are not.

Mr. SPRINGER. You are not?

Mr. HODGSON. No.

Mr. SPRINGER. Are you familiar with what any companies have done in the manufacture of sets in anticipation that color television might come into existence; what they have done about facing this problem?

Mr. HODGSON. I know of no company that has manufactured sets to receive the field-sequential color. I believe Dr. Stanton testified to that point yesterday.

Mr. SPRINGER. Have any of these companies anticipated the building of the black-and-white set that there would be color television approved and you could make that transition easily?

Mr. HODGSON. I do not think the anticipation has gone any further than perhaps a knob that said color on it. I do not think it is possible to anticipate, circuitwise, what the system is going to be. I mean, companies are now building sets on a very limited basis, receivers for the purpose of field testing the compatibile system.

Mr. SPRINGER. Well, I was so informed a couple of days ago by a person that I considered reliable, that they were manufacturing such sets which could be converted for about $50.

Mr. HODGSON. Well, that is very interesting.

Mr. SPRINGER. And that had been built into the present set certain things which cost that company about $50.

Mr. HODGSON. Did they say what color system they expected it to receive?

Mr. SPRINGER. That part I did not get. So, you might be right that it was the field sequential system. But, that was a statement that was made.

Now, I checked on that. I went to a store yesterday afternoon and found out to my surprise that the statement was true.

I am just wondering if other companies are doing the same thing.

Mr. HODGSON. I would not know. I find this statment a little confusing.

Mr. SPRINGER. I would say the person who made that statement was every bit as good an authority as you are.

Mr. HODGSON. I do not doubt it.

Mr. SPRINGER. That is why I have been wondering, in the course of these whole hearings, as to whether or not this transition period is going to be as difficult as I am led to believe here by the many people who have not testified, who certainly are eminent in the field as you are and the two witnesses who have preceded you, and it was a surprise to me to know that there was an opinion that people were manufacturing sets in anticipation that they will be able to do that.

Mr. HODGSON. It comes as a great surprise to me.

Mr. SPRINGER. Now, you would revise your opinion considerably, would you not, if you were to find out that to be true, that you could do that for about $50, as to whether or not it is economically feasible to make that transition, for a man who owns a black-and-white set.

Mr. HODGSON. I am afraid I would have to know a great deal more about what the set manufacturer assumed was necessary to prepare the set for receiving color.

Mr. SPRINGER. My question was, you would revise your opinion as to the cost of it. I mean, the difference that the black-and-white receivers would have to overcome in making this transition, would you, if it could be done for $50?

Mr. HODGSON. Well, I think the facts speak for themselves; yes.

Mr. SPRINGER. If it could be done for about $50, then it would be your opinion that most people would make that kind of an addition to their set rather than buy new sets, would they not?

Mr. HODGSON. It would seem reasonable. Now, you find the same estimate being made regarding the adaptation of the present black and white receivers to receive UHF black and white pictures, for

about the same cost, and I do not think there has been any wide conversions of black and white receivers to receive UHF channels.

Mr. SPRINGER. Are you, in your business, are you in the producing end too? Are you in the producing end, producing any shows or programs, or selling advertising?

Mr. HODGSON. No; I am not.

Mr. SPRINGER. You are not in that field?

Mr. HODGSON. No.

Mr. SPRINGER. I believe that is all, Mr. Chairman.

Mr. DEROUNIAN. Mr. Chairman.

The CHAIRMAN. Mr. Derounian.

Mr. DEROUNIAN. Mr. Hodgson, you say that the existing black and white receivers can be converted to receive the field sequential system in color?

Mr. HODGSON. Yes.

Mr. DEROUNIAN. That is definitely your statement?

Mr. HODGSON. That sir is right.

Mr. DEROUNIAN. That is all.

The CHAIRMAN. Are there any further questions? If not, I want to express on behalf of the committee, Mr. Hodgson, our very great appreciation for your appearance today. I consider that you have not only been asked questions on engineering, which would be in your field, but legal questions have been presented to you that are very difficult; merchandising questions, advertising questions, cost-accounting questions, and questions on the extent of the inflation, and the influence of the delay on the price of new sets, and on all of these questions I think you have acquitted yourself admirably.

Mr. HODGSON. I appreciate that, Mr. Chairman.

The CHAIRMAN. On behalf of the committe, I want to say that we appreciate the very fine statement that you have made.

Mr. HODGSON. Thank you.

(The following supplementary statement was later submitted by Mr. Hodgson:)

SUPPLEMENTARY STATEMENT OF RICHARD HODGSON, PRESIDENT, CHROMATIC TELEVISION LABORATORIES, INC., BEFORE THE HOUSE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE COLOR TELEVISION HEARINGS

The chairman of this committee announced at the hearings in Washington that the committee would welcome any supplementary statements by any of the participants in this hearing. Chromatic desires to avail itself of this opportunity.

I believe it will be helpful to this committee if certain factors involved in the NTSC demonstration at Princeton and the NTSC demonstration at Chromatic's laboratory in New York were clarified.

Chromatic demonstrated to the committee two different receivers operating on NTSC standards using the Lawrence tube. The first receiver utilized a circuit which switched the colors on the tube at the rate of 3.58 megacycles. The second receiver demonstrated a new concept of random switching in which the colors on the tube were switched in a random way at a rate of approximately 15 kilocycles. Neither receiver represented the ultimate in switching circuit design, and many improvements and simplifications can be expected. The receiver utilizing random switching was shown for the first time at this demonstration to the committee, and represents only the very earliest stage of development of the random concept.

RCA demonstrated three types of tri-color tubes at Princeton:

1. A 16-inch, 3-gun, mask tube—according to RCA's statement—had a picture size of approximately 9 by 12 inches and operated at between 20,000 and 25,000 volts to provide a picture approximately 10 foot-lamberts of brightness.

2. A larger 3-gun tube had a 21-inch diameter and provided a picture 12 by 16 inches. It operated at 30,000 volts, but still only provided a brightness of approximately 10 foot-lamberts.

3. The third tube was one which apparently incorporated the focusing principles of the Lawrence tube. This was considerably brighter.

The Lawrence tubes demonstrated in New York provided a color picture of approximately the same size as the largest RCA tube shown—but required operation at only 17,000 volts and yet had a brightness of 22 foot-lamberts on the receiver being switched at 3.58 megacycles. This is more than twice the brightness attained by the equivalent sized RCA mask tube. On the random switched NTSC receiver, approximately 40 foot-lamberts of brightness was obtained at only 17,000 volts. It should be noted that the economics of home TV receiver design require that voltages remain under 20,000.

The committee will recall that, as a result of the relatively low tube brightness of the RCA tubes, the demonstrations at Princeton were conducted in an auditorium in which all lights had been extinguished with the exception of the low, indirect lighting behind each receiver. At the Chromatic demonstration in New York, the room illumination was maintained at all times at a brightness sufficient to permit reading and, at one time, the room lights were turned up to their fullest brightness to demonstrate that the picture of the Lawrence tube did not desaturate.

Although the overall quality of the NTSC color television signal at Princeton was exceedingly good, examination of the picture from normal viewing distances indicated that the inherent problems of the RCA 3-gun, mask tube were still present, namely: extreme color fringing and lack of color registry of the picture. On one tube, for example, RCA engineers apparently found it necessary to go to the extreme of placing a magnet on the outside of the tube in an attempt to correct color contamination.

The third tube which RCA demonstrated was stated to employ the equivalent of a mask—this time used for focusing rather than as a shadow mask. The focusing principle is the one developed by Dr. Lawrence and is inherent in the Lawrence tube. It was responsible for the higher brightness attained by this tube at the Princeton demonstration. It was gratifying to note the comparative improvement in picture quality on the RCA version of the Lawrence tube.

I can state the above comparisons as a matter of personal knowledge, having attended a repeat demonstration at Princeton on Thursday, April 16. I emphasize these factors because the industry discussions stimulated by the committee's inquiry into color television have consistently pointed up the fact that the tricolor picture tube is the key to the quality of the color picture and the cost and early availability of color television receivers.

Permit me to add a brief reference to Dr. Du Mont's testimony. On page 289 of the record, Dr. Du Mont stated after examining a picture of the Lawrence tube, that it was "more or less of a type that we had given up a long while ago, the so-called round tube." Let me make it perfectly clear to the committee that the electrons responsible for the color pictures in the Lawrence tube have no predeliction for round or rectangular tube shapes. As a matter of fact, our next tube design will be a 28 inch rectangular tube. In this connection, Dr. Du Mont apparently did not recall that his company's presently highly advertised 30-inch black and white tube is a round tube.

In conclusion, may I express my appreciation to this committee for the patience and courtesy extended to all the witnesses throughout this hearing. We have already seen evidence that the committee's interest in the color television situation has borne fruit. We hope that it will hasten the day when good quality color television will be available to the mass of the American people.

The CHAIRMAN. The committee will stand in recess until 2 o'clock.

(Thereupon, at 12:05 p. m., the committee took a recess until 2 p. m. of the same day.)

AFTER RECESS

(The committee reconvened at 2 p. m.)

The CHAIRMAN. The committee will come to order, please. Our witness this afternoon will be Dr. Allen B. Du Mont. Dr. Du Mont needs no introduction. The name DuMont is a household byword in any

Washington home which has a television set since one of our great networks bears Dr. Du Mont's name.

Dr. Du Mont was born in Brooklyn, N. Y. He received his engineering education at the Rensselaer Polytechnic Institute, Troy, N. Y. After his graduation, he became associated with the Westinghouse Lamp Co., Bloomfield, N. J. In 1928, he became chief engineer of the De Forest Radio Co., Passaic, N. J. Since 1931, Dr. Du Mont has been president of the Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

If you mention the names of De Forest and Du Mont, you name two of the great in the fields of radio and television. We are honored this afternoon to have Dr. Du Mont here in person to give us his views on the present status of color television.

You may proceed, Dr. Du Mont.

STATEMENT OF ALLEN B. DU MONT, PRESIDENT, ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J.

Dr. DU MONT. My name, just to repeat, is Allen B. Du Mont, and I am president of the Allen B. Du Mont Laboratories of Clifton, N. J. I presume you desire me to talk this afternoon more or less on the subject, what is stopping color television being given to the public. I will try to give my views on that as best I can.

I do not have any prepared statement, but I have some notes that I will follow during this discussion.

The CHAIRMAN. Before you proceed with your statement, Doctor, if you have any associates with you whom you would care to introduce to the committee, we would be pleased to have you do so at this time.

Dr. DU MONT. I just brought one associate, Mr. Keeton Arnett, who is my assistant, if you care to stand up, and Mr. William A. Roberts, our legal counsel.

I would just briefly like to explain that as far as Du Mont Laboratories is concerned, we are in somewhat of a unique position as concerns the television industry. To my knowledge, we are the only concern that covers all phases of television, and only in television. In other words, we manufacture transmitters, we manufacture receivers, we manufacture cathode-ray tubes. We manufacture instruments for testing and the generating signals. We own and operate three television stations, one in New York, one in Pittsburgh, and one in Washington, and we have a network which has about 82 affiliated stations. So that we are dependent entirely upon television for our business.

We are not in many other businesses as some of the other concerns in this industry are. So we either make out or fail, depending upon how television goes.

We have been in business since 1931, trying to develop television. At that time, of course, the existing system in this country was a system of mechanical television where we utilized scanning disks, scanning drums, rotating prisms, and other devices to try to get a satisfactory television picture. The first television transmissions of course in this country occurred right here in Washington. Dr. Francis Jenkins for the first time succeeded in transmitting a picture over the air in 1925 here in Washington.

At about the same time, Baird in England, working independently, also succeeded in transmitting the first picture over the air.

However, just for your information, this was not the start of television by a long shot. The first television patent was issued to Ayerton and Perry in 1880. They were two Englishmen, and they had a scheme of transmitting television from place to place, utilizing a large drum of photocells, which had the picture focused on it, connecting each photocell by means of a wire to a little light gate at the receiving point, and having a multitude of light sources and light gates in front of it to reproduce the picture.

Obviously, that system was entirely impractical because in order to generate the picture of the quality we have today we would have to have about a quarter of a million photocells, wires in order to recreate the picture.

In 1883 an Austrian by the name of Nipkow invented the principle of scanning which we use today. That particular invention simply consisted of taking the picture and focusing the picture on a rotating disk with a series of holes arranged in the form of a spiral on the disk, and, as the disk passed over the part of the picture, it would break the picture up electrically so it could be sent over a signal circuit or single radio-television transmitter. At the receiving point the picture was reformed in just more or less the reverse manner. You had another scanning disk with a series of holes in it, you rotated the disk at the same speed as the disk at the transmitter, and you had a neon-light source back of that disk that varied in intensity corresponding to the variation in the intensity at the transmitting point.

However, it took from 1883 to 1925 to actually be able to transmit a picture over the air. That seems a rather long time, and it is, but in 1883, the photocells were not sensitive enough, we did not have amplifier tubes, and many other things, in order to make this work. The first time that these all came together was in 1925, when these various developments had taken place.

From 1925 to 1931, as I mentioned before, the people that were in the industry were attempting to develop television by means of this mechanical system. Around 1931 the people working on this decided that if it was going to be satisfactory, we would have to have an electronic system of television, and various people in the industry worked on electronic pickup tubes, such as Dr. Swarken, of RCA, and other people, concentrated on the development of the reproducing tube, the so-called cathode-ray tube.

Our concern happened to be the first concern in this country to put out cathode-ray tubes commercially. We manufactured tubes 3 or 4 years before any other concerns in this country, and we did a lot of the pioneer development work of the reproducing tube.

However, in 1931, the pictures were very, very crude. We only used 48 lines in the picture. Several years thereafter, we increased the number of lines to 60, and then we gradually, over the years, increased it to 120 lines, 243, 343, 441, until we come up to 1941, when we had the first hearing by the Federal Communications Commission to try and decide and standardize upon a system of television.

At that hearing there were many things that were argued back and forth by the members of the industry, and there was a committee formed, an industry committee, that finally resolved these standards,

submitted the standards to the FCC, and they were finally put into effect.

At that particular time, we took the attitude that we wanted to see a standard set in this industry that would last for a very long time. We were not anxious to see a standard set where the picture did not compare with competing media. For instance, if you had too many lines in the picture, the picture would not have the necessary quality so that people would compare it favorably with a motion picture. The standard that was finally set was 525 lines, although many in the industry wanted to settle for 441. We had recommended 625, but the 525 worked out as a compromise and, as you know, we now have very, very high standards in black and white television.

To get into this subject of color, we feel the same thing as far as the standards for color are concerned. We feel that the standards should be high enough so that the picture would compare reasonably well with the best pictures you get in the motion-picture houses. Otherwise, if the color is poor, if the picture is not sharp and crisp, we feel that the television industry will be definitely limited.

The hearings and the controversies that have gone on since around 1941 to a large extent have been along those lines. In 1940, for instance, when CBS proposed their first system of color television, they proposed that there be only 20 pictures per second transmitted. They proposed that there only be 343 lines in the picture. Obviously you do not have as good detail with 343 lines as we have with our present black and white standards of 525. With only 20 pictures per second, if the picture is at all bright, you get a very annoying flicker. With our present system we transmit 30 pictures per second. The industry felt that the color standards should conform to at least as good as the black and white standard. In other words, if you are going to offer something to the public that is not as good as what you have, we do not think you can sell it, and we do not think the public will be satisfied with it. We think that color television should be fundamentally as crisp and clear as black and white, and have the color added.

We come along to 1948, and another system was proposed by Columbia. There had been some in the interim period. In other words, there were actually three separate systems that Columbia had proposed. The system as proposed in 1948 was somewhat better than the one in 1940. In other words, they had increased the number of lines to 405 from 343, and they had increased the number of pictures per second to 24, as compared with their original 20. However, neither one of these standards compared with the standards that we had in black and white. We felt that the black and white standards were a minimum which we should not go below. The industry was practically unanimously opposed to this system, to a certain extent because of these lower standards, but to a considerable extent because the system was not compatible. You undoubtedly from these last few days are familiar with what compatible and noncompatible mean, but from the standpoint of the commercial broadcaster, it is almost an impossibility with a noncompatible system, because he starts out without any viewers, and he has to promote an entirely new medium, and he would go broke before he could ever get started.

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There were other difficulties with the embodiment of this system as shown by Columbia. In this Popular Mechanics there just happened to be an article on page 150 here which I would like to refer to. There is a photograph on page 153, which shows what you get into when you try to get a large picture with the mechanical system as then was being used by Columbia. In other words, the most popular size television tube today is the 21-inch cathode-ray tube. In order to get a color picture with the system as they demonstrated, with a motor and a rotating color disk, they would need a disk some 4 feet in diameter with a 5-horsepower motor on it. It is pretty obvious that something like that is not too practical for the living room.

The CHAIRMAN. Dr. Du Mont, I have been looking at the article to which you have just referred, appearing in Popular Mechanics magazine in March, 1953, an article in which you answers questions, all of which have a direct bearing upon the subject of color television and its future, and I am of the opinion that in view of the fact that you do not have a prepared statement to put in the record, that it would be well in connection with the comments that you are making at this time, to include this entire article as a part of your testimony.

Dr. DU MONT. I would be very happy to do that. This article happened to be written before this hearing was called. It was written several months ago, but the answers I have given to the questions here I have not changed my mind in any manner.

(The article is as follows:)

WHAT'S AHEAD IN TV

Allen B. Du Mont, television pioneer and president of Allen B. Du Mont Laboratories, Inc., in an interview with Popular Mechanics editors gives a preview of the next 10 years on your television screen

Question. Two years ago you objected to the efforts that were being made to establish a system of color TV. Do you still feel we're not ready for color?

Answer. The objections I voiced had to do with the quality of the proposed systems. We have had color for some time. In 1928, Baird demonstrated it in England. We had hearings in this country in 1941 and 1946. At those times the Federal Communications Commission decided it was not ready. Then, in 1948, we had additional hearings. In spite of the fact that the industry was unanimously opposed to the introduction of color, the Commission went ahead and standardized on a system that I felt never had a chance. That particular system was an incompatible system, fundamentally mechanical. The larger you made the picture the more difficult it became. For instance, if you wanted a color picture on the 21-inch receivers we have today, you would need a 6½-foot color disk and a 15-horsepower motor on it. It is quite obvious that this is not practical in the home.

Question. What about the rotating-drum type?

Answer. It makes the set a little smaller, but it is still a tremendous apparatus, with about 2½ times the cubic content of the present set. There are many other objections. It has only a third the detail of present black-and-white sets. Furthermore, you only transmit 24 pictures a second, so if you have a bright picture, you get flicker. A terrific disadvantage is the fact that it is incompatible. When you transmit those color signals over the air, none of the black-and-white sets can receive it unless you put this tremendous disk or drum in front of the cathode-ray tube and make changes in sweep circuits and various components. The reason I have been opposed to color is that I did not think this system was ready. Another system proposed in the 1948 hearings, the so-called electronic system, had just been born. It was not, and still is not, ready. After the hearings, major manufacturers formed the National Television System Committee. This committee has been trying to develop a satisfactory electronic system. They are now transmitting daily experimental programs for field testing in Philadelphia, New York, Syracuse, and Chicago. Our tests show that circuitwise the thing looks pretty good. The difficulty at present is the factory

cost of the cathode-ray tube—about $200. That means a 17-inch table-model set would sell for between $600 and $700, or possibly more. There is another objection. The color picture is not as sharp as black and white. It is a serious problem to register three colors. That problem, together with the cost of the tube, has to be solved before color is commercially practical.

Question. Will development of the new tricolor tube help speed things along?

Answer. It is a step in the right direction. So is the system they are working on. This electronic system is compatible. You can transmit these color signals over the air and they can be received excellently by all the present black-and-white receivers. Furthermore, this system has the potential of providing just as good a detail as the present black-and-white system. Thirty pictures are transmitted per second, as they are in the present system, so you have no apparent flicker. It also has the advantage that the larger you make the picture the easier it is to make the tube, which is just the reverse of the other system.

Question. When am I likely to be able to buy a color-television set?

Answer. Just a rough guess would be 5 to 10 years from now. In my estimation, it will be at least a year before the NTSC will be able to submit the system to the FCC. Judging by the speed the FCC has shown in the past, I would be surprised if they decided on anything sooner than 3 years after they received it. That makes 4 years. It will take at least a year after that for maunfacturers to tool up and get into production. So, 5 years, with everything going right, would be the absolute minimum. I think it will be longer than that. Even when we have color, the receiver will always cost about twice as much as a corresponding black-and-white receiver. And I think color programs will always be a relatively small percentage of the total programs transmitted. I cannot see where color will supplant black and white for many years, if ever. Your receiver is more expensive. It costs much more to put those programs on the air. You had had the same situation in color movies. Today only about 20 percent of all movies are made in color.

Question. Are there any startling advances in the wind for black-and-white television?

Answer. There have been terrific advances since 1946. We have gone from a small to a large tube so people can sit anywhere in the living room and comfortably see the picture. We have gone from a round tube to a rectangular tube, which allows a smaller cabinet for an equivalent size and more pleasing picture. Another advance is the use of a filter face in the cathode-ray tube. What that does is to give you a good picture in a normally illuminated room without losing contrast. The use of a cylindrical instead of a spherical face lets you sit in a room with lights lit and the light does not reflect back. Another advance you'll see more and more is the self-focusing cathode-ray tube. All these things are what happened just to the tube. Noise immunity of sets has been improved tremendously. In the early days, automobile ignition, diathermy and so forth, would cause the picture to jump around. Now you can have a steady picture even in places so remote you can hardly see the image. The complexity of the controls has gone way down. We never had much trouble teaching the kids to run the set, but people over 40 had a heck of a time tuning them. Now even grownups can tune a set. We have found out how to do things with less parts and less tubes. Cost has come down and the reliability has gone up.

Question. Are there any startling improvements that we may see in the next year or two?

Answer. Now, with the lifting of the band freeze, the FCC has added 70 additional channels. So people in the remote parts of the country will soon be able to receive TV signals. It costs more to put in a tuner that covers the 82 channels, so I think more expensive models will have 82 channels. Other models will have only 12 channels. In the models with 12 channels, if you are in a district where there are ultrahigh-frequency transmitters, you can put a "strip" in the set. It is a much cheaper way of doing it.

Question. Would you explain just what the new UHF channels will do for TV?

Answer. These ultrahigh frequencies give 70 additional channels, so we can have a nationwide competitive service. With only 12 channels you cannot do that. You have to space your stations 170 or 180 miles apart. And you cannot have 3 or 4 stations in the major towns. With this new allocation scheme, practically every town of over 5,000 population will have its own local television channel.

Question. There are no systems in use, to your knowledge, that would eliminate the necessity for having microwave stations at such frequent intervals?

Answer. Absolutely not.

Question. I had heard that you were working on a light-wave system and hoped you might want to say something about that.

Answer. We have been working on a system of transmitting television by means of a light beam, but in that particular case you still have to have stations throughout the country to transmit from place to place. As a matter of fact, with a light beam they would probably have to be closer together.

Question. What would be the advantage of the light beam?

Answer. We have been working on it to try to provide a method of distributing television programs to the smaller cities that can't afford ultrahigh-frequency programs. It costs between $50,000 and $100,000 minimum for a small UHF station. We are hopeful that our system would provide a transmitter for a small city for between $5,000 and $10,000. It is purely economics. It would be good only for an area 5 miles from the transmitting point.

Question. Approximately what stage of development has your light-beam TV reached?

Answer. We have been working on it for 4 or 5 years and all I can say is that we are making progress. When we started we could only transmit 50 feet. Now we are up to about a mile and a half or 2 miles. We want to expand that even more before we go ahead commercially with it.

Question. Is there any advantage to building microwave links for TV around the world?

Answer. Microwave circuits are utilized for telephone as well as television signals. They can transmit over a single circuit about 720 telephone conversations simultaneously, and it is a cheaper arrangement. I think ultimately it might pay the telephone people to build microwave circuits to Europe. If they do that, television circuits likewise would be available. From what I have seen of the programs in Europe, I doubt whether many of them would get much of a Hooper rating over here. On the other hand, some big event like the coronation this year would be of interest. Of course, they can take that on film and get it over here in pretty short order. But if you had microwave circuits, your difference in time of 5 hours would mean that you would do the same thing we are doing on the coast now. Most of our programs for coast distribution are filmed and run at a later time. That is all you would use the microwave circuit to Europe for in most cases.

Question. Is there anything afoot that will beam signals transatlantic or transpacific?

Answer. I have seen a lot of proposals. They have talked about putting a cable to Europe; also of extending the microwave circuits, which now go to Quebec, up through Labrador, Greenland, Iceland, and then the Faroe Islands. Theoretically, I think it can be done. A circuit would require hops of not much more than 250 miles. By using the low end of the VHF band, I think it is possible to do that. If we could get the proper shortwave frequencies now allotted to radio and so on we could transmit television throughout the world. Someday it may be important to do so. If it can solve all this fighting and create a better understanding among people, it might be more important than the circuits we have today.

Question. Are there any other things on the fire that are likely to simplify television sets so that the set owner is not faced with heavy repair problems?

Answer. In our new sets, terminals are right at the back of the receiver. A serviceman can put his test instruments on without having to take the chassis out, which speeds things up. New safety glass in front can be removed to change the tube without taking the chassis out of the set. Other manufacturers are following suit.

Question. What about transistors? Are they likely to figure in television sets soon, and will that influence size of sets?

Answer. At the present time transistors are in the development stage. They have great possibilities for reducing the size and weight of the television receiver. At the present time the cost of manufacturing transistors is extremely high so that from a commercial standpoint it is not practical to use them. Transistors suitable for replacing certain tubes in a television set cost from $12 to $24 apiece, as compared with the cost of tubes which might run from 25 to 50 cents apiece. If the manufacturing processes for transistors can be improved and the cost brought down, they will probably have a wide application in this field.

Question. Will there ever be portable sets and small table models comparable to the little table model and walkie-talkie radios?

Answer. For bedside use and for mobile use it is possible. Of course, you will have a smaller picture in that receiver.

Question. Do you think that perhaps in the next 5 years we may see these smaller sets of a portable nature?

Answer. I think there is a good chance that they may come to pass for a specialty market.

Question. There has been a lot of talk about education by television. What is the cost of setting up a small station in a university and televising programs for classrooms?

Answer. Sets run between $200 and $300, depending on picture size. The transmitter costs between $50,000 and $100,000. Cameras and control equipment would add another $50,000 or $75,000. That would be an absolute-minimum station. Schools in Philadelphia, Los Angeles, and the Montclair State Teachers College have been doing a lot of experimental work with it. They take a central spot and use the finest professors for instruction throughout the whole State. It should, if it works properly, increase the general level of education and I think it may result in certain economies over what we have today.

Question. Why wouldn't it be cheaper to do this on film and have projectors in the classroom? There is no time element involved in it, is there?

Answer. I think there is a time element involved in certain subjects—political history, for example. The cost of putting it on film, as we found in commercial broadcasting, is generally 2 to 3 times as much as direct pickup. And educators have found that there is something in the intimacy you get by transmitting the programs simultaneously. You lost it in the film. There's another use of television in education at Western Reserve. They have been running actual college-credit courses over a commercial station in Cleveland. A person, by paying the normal tuition fee, can take that course and, at the end, go to the college, take the examination and get full college credit. Of course, anybody can look in and get the information free, but they must pay the fee to take the examination. The lecture over television was 30 minutes instead of 55 minutes as in the college, but students taking it over television had a 15 percent better grade. The reason, according to the president of Western Reserve, was that they used the finest professors on television. Secondly, those professors spent about 7 hours in preparation of every lecture. It is much finer instruction. With overcrowded schools it indicates that, with proper teaching, you might give a person better education in a half day than you do now in a full day, and utilize the schools to a greater advantage. Critics who feel that people will tune in educational programs to the exclusion of entertainment programs, I think, are greatly exaggerating.

Question. Will there be more of this type of education via TV in the next 2 or 3 years?

Answer: Yes.

Question. Will it be on national hookups or just in local areas?

Answer: That is hard to say, but I think it will start with local rather than national.

Question. What are some of the new things coming up out of the laboratories for TV?

Answer. We have developed much cheaper cameras that are simpler and have fewer controls. They can be left on indefinitely for things like smoke control. The camera monitors the stack. Down in the furnaceroom men know exactly what is going on up there at any time. They are used to watch dangerous operations like blast furnaces, testing of jet engines, and so forth. Television will be used extensively in connection with guided missiles. Several weeks ago the Army in Korea sent pilotless bombing planes out equipped with television which guided the planes right to the spot they wanted to bomb. We have supplied quite a bit of three-dimensional equipment to the Atomic Energy Commission. The three-dimensional feature allows them to operate controls remotely.

Question. Is three-dimensional TV a feature that the consumer is liable to see?

Answer. I don't think so. It requires about twice the band width for the transmitter. With all allocations already made it would mean a complete revision of allocations. Furthermore, you have to wear special glasses with Polaroid lenses or you have to have glasses with red in one eye and green in the other. To get people to put on glasses to look at television, I think, is something that is pretty hard to do.

Question. What do you see for television in the distant future for the average consumer?

Answer. With all the new stations going up within 2 or 3 years, the networks can afford to spend more money for programs because if they can distribute programs widely enough the cost per listener is decreased and this will mean vastly better programs throughout the country. Another thing: At present there is only 1 microwave circuit to the coast, so people there can only see 1 network show at a time. In a short time we will probably have 4 microwaves to the coast; 1 for each network. I think the public can look for greatly improved programs over the next 5 years.

Dr. DU MONT. I would simply like to make one correction that inadvertently slipped in on page 150, the third line from the bottom, where they refer to a 21-inch receiver. It should be a 30-inch receiver. In that case we need a 6½-foot disk and a 15-horsepower motor.

With that correction, I will stand on the article, and it expresses my feelings on this thing.

At the time the hearings were held in 1948, another system of color was proposed by the Radio Corporation of America, the so-called dot sequential system. At the time it was shown, it had only been born a short time previous to that, and it needed a lot of development work before it would be in shape to commercialize. I do not think there is any question that the pictures Columbia showed were better than the pictures shown on this other system at that particular time. However, we tried to point out to the Commission that it was not a question of deciding which was better of two things that were not satisfactory, but it was a question of waiting until we had a system that was satisfactory, and then standardizing upon it.

However, that was not done. They picked the best one at the time and standardized upon it.

The development, of course, of this dot sequential system has progressed quite rapidly. At the present time the standards have been changed a number of times since the original hearing, and much better results are being obtained. Our feeling, however, is that there is still further work to be done on that particular system before it is ready for standardization. It looks to us about the best thing we have seen, and it looks the most promising thing we have seen. But we feel at the present time it is somewhat complicated, both at the transmitter, which is not too important, but where it is important is at the receiving point, because if it is complicated, it is more difficult to service and costs more money to build.

I would just like to refer to what actually happened as far as the Columbia system is concerned. After it was standardized upon, Columbia did put some programs on the air. They did not put them on, however, in the evening hours. They are pretty much in the afternoon and morning. But they did have color programs on the air. They did manufacture sets and they tried to sell those sets. As near as I have been able to determine, they made some five or six hundred sets, and after a period of 5 or 6 months, they succeeded in selling less than 100 of those receivers.

It is pretty obvious why they could not sell the receivers. In the first place, the receivers cost about $650, and they had a 10-inch picture on it. Competition was selling at that time black and white receivers with a 17-inch picture for around $225. You had a choice there that just did not work in favor of the color receiver. So when we had this order that I heard discussed this morning—I believe it is MP–90, I am not exactly certain—when they originally told about

stopping color television to help the war effort, we made a lot of noise about it, because in our estimation there was no color television production, there was no threat of color television production, and this was simply a move made to take Columbia off the hook, if you want to refer to it that way. In other words, they were not going anywhere and they were perfectly willing to quit, but they did not want to admit it.

I think a lot of the discussion on the MP–90 order is theoretical. Actually the thing was not taking any material and it had no chance of taking any material. The public is the one that kicked this out. It was not any of the industry. They did not go ahead with it because they did not feel they could sell this system, and until we get a system that you can sell to the public, you cannot accomplish anything. Obviously the whole industry is for the benefit of the public, but you have to have pictures that are clear enough and the receivers are simple and cheap enough so that public will buy it. It is interesting to note that of the sets sold last year, about 80 percent of the sets have a list price of less than $300. With this present NTS system it is likewise an expensive set to build. I would estimate from the tests we have made, and the experiments we have made, that in order to make a 17-inch table model receiver in color by this system, the cost would be somewhere in the neighborhood of $650 as against $199 for a black and white receiver. So I feel if we put it out now, the market will be extremely limited for the color television receiver.

My own personal idea is that we are going to have black and white television with us for many, many years. You cannot look too far ahead. There may be some miracles that will happen that will ultimately bring the cost of the color receiver down the same as the black and white. But until we see some sign of that you more or less have to take the attitude that for a long period of time both black and white and color sets will be sold at the same time.

The actual fact is that it will take many years before the industry will be in a position—that is broadcasting industry—so they can transmit all the pictures in color. The increased cost of film, the fact that there is very little color film available for color television, most of the color films have been made recently. There was a prohibition by the union with regard to using those films on television. So there are many economic factors to my mind will mean for a long period of time there will be certain programs in color, but the bulk of the programs will be in black and white.

Furthermore, as far as I can see, even looking quite a distance ahead, I think the color receiver will always cost about 50 percent more than the black and white receiver, which will mean that the market for color receivers will not be nearly as great as for black and white receivers.

In this annual report for 1952 of our company, which you have in front of you, you will notice on page 11 we have a little note that covers some of the work and so forth that we have been doing in connection with color television and more or less our ideas in that connection which are along the lines I have discussed. It says:

Research by your company and the television industry is continuing in various approaches to the problem of broadcasting television in full color. Extensive transmission of color signals were made during the past year by Du Mont Laboratories from our experimental transmitter in New York City.

Actually we transmitted 8 hours a day for practically the whole year.

At its current status color television still requires extremely elaborate equipment, and considerable simplification must be made before color television becomes commercially practical. Your company is active in refinements of color cathode-ray tubes and cameras, as well as complete systems.

Appropriate consideration for the compatibility of any new color television system with existing black and white reception is imperative in the company's view. Although progress on a compatible electronic system shows great promise, the entire system will probably take at least 5 years to reach a position of widespread use.

Research on the many aspects of color television has found a multitude of uses in military equipment. A considerable amount of broad-band closed circuit television equipment has been delivered to various branches of the Armed Forces.

I might mention some of the work we have done in connection with color. From 1931 until to date, this company has been in the forefront of development in all phases of television work. If you go back to 1946, when we first started commercial television, we manufactured 12-inch and 20-inch cathode-ray tubes, when the rest of the industry were satisfied with 7- and 10-inch. We have led that parade since then.

We have always felt that the larger tube, up to a certain size, was much more practical for a home. In other words, with a 7- or 10-inch tube everybody had to give up their normal living habits and crowd around a television set. With a tube of 21 inches, it is possible to look at television and still sit around the room, and if you are reading or your wife is sewing, they can do that without crowding around the set. But the point is that the average size of picture tubes has gone up from a 7-inch tube at the start so that 21-inch is the most popular size now, and there is a good chance that within another year it will go up to 24 inches.

I think there is a limit to it, but we have pushed that, and have been continuously above the rest of the industry as far as picture size is concerned.

As far as experimental work on color is concerned, we have done a lot of work on the cathode-ray tube, and we have tried many variations of the cathode-ray tube to try to come up with an answer. We have some promising work that is going on, but we do not pretend we have the final solution to it. We have obtained numerous patents, of course, in connection with the three-color tube work we have done.

As far as the Columbia system is concerned, we just did not turn it down because we did not investigate it. We set up a transmitter to transmit pictures by that system. We spent a lot of money manufacturing receivers and trying to see if there was not an answer to coming up with a practical receiver. We spent many, many thousands of dollars. Just one instance, there was a very fine machine design place down in Washington, and we paid them $30,000 to build an experimental drum receiver for us to see if they could not do it better than we could do. I simply bring this up to let you people know that as far as we are concerned, being in the position we are, we would like to see color television tomorrow if we thought the public would buy it. It is pretty obvious today that in our big cities between 80 and 90 percent of the homes are equipped with black and white television, and if we could put something new like color

television in today, it would help the television industry tremendously.

On the other hand, if we try to go ahead with something that is not practical or before it is ready, it is going to do a lot of damage to the industry, because people are unsettled as to whether they should wait and get a color television set or buy a black and white receiver and get the benefit of the programs we have on the air today.

I think that pretty well covers my thoughts in the matter, and if there are any questions that I can answer, I will be happy to do it.

The CHAIRMAN. I have nothing more to say other than what I have said as to the privilege granted to you to include in you complete remarks the article appearing in the magazine to which reference has been made. In addition thereto, there may be portions of the Allen B. Du Mont Laboratories, Inc. annual report that may contain some information of particular significance, if so you may likewise include such parts of that in your statement.

My reason for making this suggestion is the fact that you have spoken extemporaneously—very well, indeed—and have said a lot in a very short time and with very few words, yet I feel in going over the matter you may feel that there are parts you wish to clarify and expand.

In order that the committee may have the fullest opportunity to know your viewpoint, I am making this suggestion to you, if you wish to take advantage of it.

Dr. DU MONT. Thank you very much. I will do that.

(The report was filed with the committee.)

The CHAIRMAN. Mr. Hinshaw.

Mr. HINSHAW. What is the situation with respect to television patents? You own some of them, I understand, RCA owns some of them. Who owns the bulk of the patents? Where do the patents lie?

Dr. DU MONT. It is a little hard to say as far as color is concerned who owns the bulk of them. I would not be really in a position to say that.

Mr. HINSHAW. Who thinks they own the bulk of them?

Dr. DU MONT. I think RCA thinks it owns the bulk of them. It undoubtedly does have a lot. There is no question about it. But there are a number of experimenters outside of RCA that have done considerable work on color—General Eelectric, Philco, CTI out on the coast, the chromatic people that spoke this morning, and many others have possible color patents.

Mr. HINSHAW. Do you think you own some of them?

Dr. DU MONT. We know we own some of them. When you talk about the validity of any patent, that is where the problem comes in.

Mr. HINSHAW. I understand there are some owned in California.

Dr. DU MONT. I mentioned CTI, Color Television Inc., in California. It was active in the 1948 television hearing.

Mr. HINSHAW. I cannot say what is the ratio of ownership because that is not factual, we will say, and neither is it factual to say that they think they own them. What is the approximate ratio of ownership?

Dr. DU MONT. Between the different companies?

Mr. HINSHAW. Yes, that they think they own.

Dr. DU MONT. I do not think I am in a position to give actual percentages.

Mr. HINSHAW. I am not asking for actual percentages. I am just talking about possibilities.

Dr. DU MONT. I can say this. If you take a look at black and white television, RCA certainly has the dominant position as far as patents are concerned. Other people have numerous patents, but practically all of your black and white patents are altogether in the RCA pool. the pool has all the General Electric patents, the Westinghouse patents, Phillips patents, and so forth. They are all in one pool. Something like that will probably occur as far as color is concerned. As a matter of fact, the color patents that RCA has are available; present licensees are licensed under those patents. We do have licensees under our patents. We have a cross-license with RCA.

Mr. HINSHAW. You have a cross-license agreement with RCA?

Dr. DU MONT. Yes.

Mr. HINSHAW. I am very much interested in this question of compatibility and noncompatibility. I hope you will give me your considered answer, and as nearly factual as possible. Is the urge to have a compatible system one that is based upon making color television as cheap as possible to the public, or is it one to maintain the highest number of listeners for the benefit of the broadcaster or telecaster?

Dr. DU MONT. I do not think specifically you can say that the decision rests entirely on compatibility and incompatibility. I can conceive of an incompatible system that the industry might push. I do not know what such a system could be but I can conceive of it. The difficulty with the incompatible system that was proposed was that it only is 405 lines, so that the resolution was decidedly inferior. It only had 24 pictures per second, therefore the flicker was considerable when you had a bright picture. It just happens that when you come to compatibility, you automatically come to the same number of pictures per second and the same number of lines in the picture as you have in your present black and white. So you have theoretically the same quality of picture. Therefore, there is something else except the difference of compatibility when you are choosing the two systems we are talking about.

I do think when you are talking about compatibility that it affects the people with receivers as well as the broadcaster. The 22 or 23 million people that have receivers today cannot, if you start an incompatible system, see anything without buying adapters, when the color transmitter is on the air. With the compatible system, they receive pictures exactly as they are. They bought a black-and-white receiver, and they receive pictures on that receiver in black and white.

So it is a great benefit to the set owner to have a compatible system.

Then of course it is pretty obvious as to the tremendous advantage to the broadcaster to have a compatible system.

Mr. HINSHAW. And the advertiser.

Mr. DU MONT. The two go together. Without the advertiser, you do not have the broadcaster; that is, with the free-enterprise television system we have in this country.

Mr. HINSHAW. That is right. I am wondering whether the effort is to maintain the highest possible number of viewers in considering

incompatibility and compatibility, or whether it is to produce the very highest grade of pictures in color. That may or may not be an incompatible system.

Dr. DU MONT. I would like to answer your question, but I am not sure I understand exactly what it is.

Mr. HINSHAW. Of course, in a compatible system, you are going to have a large number of viewers in black and white until a large number of color sets are sold, and then be viewed in color.

Dr. DU MONT. Yes.

Mr. HINSHAW. And in the incompatible system, you are going to have, perhaps, and perhaps not, a better production of picture.

Dr. DU MONT. My contention is, of course, with the incompatible system as proposed, that the picture is definitely inferior. If the incompatible system, for instance, had 1,000 lines in it and still 30 pictures a second, then you have something else to talk about. But the minute you go to those standards you need a much wider frequency band and will have considerably fewer stations on the air. I think you have to refer to a specific incompatible system and a specific compatible system in order to make your comparisons. In other words, you cannot make a generalization for incompatibility and have all different kinds of standards there. The incompatible picture could be a lot better than the compatible. In the particular system we are talking about, that was not the case.

Mr. HINSHAW. Do you think, for example, this tube that was described this morning, when applied to a so-called incompatible set, would give a satisfactory picture, or do you have a better one?

Dr. DU MONT. I do not think the tube fundamentally will give you any better picture with the incompatible system than the system Columbia had. The limiting feature is the number of lines and the number of pictures transmittted, and whether you receive them on the type of cathode-ray tube described this morning, or on the Columbia tube, the quality of the picture should not differ between the two; that is, assuming the tube described this morning gives good quality.

Mr. HINSHAW. I was sure I could find out if you also think you have a tube that is extraordinarily good and is unique.

Dr. DU MONT. No; we do not think we have, and we do not think any of the tubes we have seen is satisfactory. We do not think there is a cathode tube today that gives the defintion and picture we would like to see. We can show you in our laboratory the NTS system. We transmit that system and receive it on 3 cathode-ray tubes and we combine that picture and you get a marvellous picture that way. But you have 3 tubes in the receiver. The receiver is about the size of a telephone booth, and it is very, very expensive, and it is not practical. Any cathode-ray tube that I have seen so far—and this is a single cathode-ray tube generating the 3 colors in the 1 tube—whether it is RCA or the one mentioned this morning or the others, the registry is not perfect yet, and the picture is not nearly as good on that as it is with 3 separate color tubes.

The 3-tube arrangement does show, however, that fundamentally the NTS system can generate a very, very excellent picture. But the cathode-ray tube has not been developed in my opinion to the point where it gives the type of picture I like. We had the same problem in the early days of black and white. We had a mechanical system.

Until we had a satisfactory cathode tube, we did not have a satisfactory television picture. That is the problem we have today, the fact that the single cathode tube is not good enough, and the very, very high cost of the tube. Nor do I subscribe to some of the figures given this morning as to the cost of making that tube.

Mr. HINSHAW. I think you feel that Order M–90 ought to stay in effect for several years longer in order to restrain the television manufacturers from going to color?

Dr. DU MONT. I do not think so. I do not think until we have something satisfactory they will consider going into color television.

Mr. HINSHAW. So it is a decision on the part of the manufacturers.

Dr. DU MONT. They do not have anything to sell to the public.

Mr. HINSHAW. That is a very interesting fact. That is something that has not been brought out here before. The manufacturers themselves decline to go into the color television business.

Dr. DU MONT. I am speaking for myself now. I certainly would not put out a color television receiver that I did not think the public was going to buy. We are in business to sell television receivers, and I would not make one that I did not think I could sell.

Mr. HINSHAW. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Dolliver.

Mr. DOLLIVER. I take it, then, Dr. Du Mont, that you are not in complete agreement with some of the testimony we have heard in the last 2 days from the representatives of some of the other companies?

Dr. DU MONT. Specifically as far as the testimony of RCA is concerned, we do not feel that RCA is as far along as its testimony indicates. That is our personal opinion. RCA has its own opinion. We think it has further to go.

As far as the testimony on the noncompatible system is concerned, as I understand it, the testimony was that CBS itself was not going to press it. We think that is a very wise decision. As far as the testimony this morning on this new tube is concerned, we think it has possibilities. We think in another 3 or 4 years it might develop something.

Mr. DOLLIVER. You think it will take as long as 3 or 4 years?

Dr. DU MONT. That is right. I just happened to look, for instance, at the picture of the tube that they show here. It is more or less of a type that we had given up a long while ago, the so-called round tube. In order to make a receiver with this particular tube, you need a cabinet vastly larger than for the rectangular tubes. In other words, all this space around here is thrown away. [Indicates] That is the way Du Mont made them back in 1946. The whole industry has gone to the rectangular tube. It was very difficult to do. I know it is going to be very difficult with this. The round tube makes the sets large and difficult to sell because it makes them more expensive. It is not an easy job developing these tubes.

I am not criticizing these people at all, but we have been in the cathode-ray tube business longer than anybody in the country, and we think we know the problems connected with it. I do not think this tube is ready.

Mr. DOLLIVER. When you refer to a cathode-ray tube you are refering to the large tube that is used to receive television pictures?

Dr. DU MONT. That is correct.

Mr. DOLLIVER. That is the technical or trade name for that type of tube, is it?

Dr. DU MONT. That is correct.

Mr. DOLLIVER. I would like to explore your mind a little bit about the method and procedure of developing the color television. I take it that the industry and the committee and the Commission and the public, too, are more or less unanimous on the idea that ultimately we should have color television, that it is a definite improvement and a better medium of information, education, and entertainment than is given in black and white television.

Now, as you pointed out, and we have heard the opinions of some others how it should be developed, as I recall, Dr. Engstrom said they were ready to start broadcasting on color television tomorrow.

Dr. DU MONT. That is true, but I do not consider that the picture is good enough, and that the system is simple enough and No. 3, that the sets will be cheap enough in price. We broadcast color 8 hours a day, but the reason we do it is that we are trying to develop new methods all the time. The physical possibility of transmitting color has been here for some time.

Mr. DOLLIVER. You say you are now transmitting in color 8 hours a day.

Dr. DU MONT. Yes, for experimental purposes.

Mr. DOLLIVER. For experimental purposes only?

Dr. DU MONT. That is right.

Mr. DOLLIVER. Would there be any advantage in your opinion in starting a broadcast in color in a compatible system that can be received in black and white?

Dr. DU MONT. We are doing that.

Mr. DOLLIVER. But not commercially?

Dr. DU MONT. No, experimentally.

Mr. DOLLIVER. Would there be any advantage in transmitting in color commercially?

Dr. DU MONT. I do not know that there would be any advantage. I do not think there would be any distinct disadvantage. Members of the industry have asked the FCC for some time now to allow them to broadcast the compatible system during regular hours. The FCC refuses to permit it. Unless an experimenter has a special frequency which we have in New York, experimental work must be done between 12 o'clock at night and 7 o'clock in the morning, which is tough on everybody. It would help if the FCC allowed some of the daily programs to be transmitted in color and nobody would know the difference anyway, and we would get a lot of useful information.

Mr. DOLLIVER. That is precisely the point I am making. Do I gather it is your opinion from what you have said that it might be a good thing for the early development of color television for the FCC to permit commercial broadcasts in color receivable on the present type receivers? Maybe you are not ready to express an opinion on that, but if you are, I would like to hear it.

Dr. DU MONT. My only question is the commercial end of it. I would like to think about that a little. We have many sustaining programs however that could be transmitted in color and we could get faster experience than we get by our present method.

Mr. DOLLIVER. Would it not be a fact, Dr. Du Mont, if that were permitted, it would open up the possibility of further commercial ex-

perimentation with the receiving sets which you say now are incompatible or not up to standard, and give a possibility for a commercial development of the receiving, if there were color to be received?

Dr. Du Mont. I think it would help considerably; yes.

Mr. Dolliver. Now, let me clarify for my own sake—I think you television technicians understand this much better than I do, and perhaps other members of the committee—as to the question of standards and compatibility. Do I understand that the compatibility is based on the number of lines and the rapidity of the change of the picture?

Dr. Du Mont. Among other things.

Mr. Dolliver. Those are two of the factors.

Dr. DuMont. Those are two of the most important.

Mr. Dolliver. What other items are included in compatibility?

Dr. Du Mont. The method of synchronizing pulse, the blanking interval, and so forth. It just happens as far as color and black and white are concerned, those things fall in pretty well together. The most important are the number of pictures and the lines per picture. Those are the two important factors.

Mr. Dolliver. What the the standards acceptable by the FCC in those two respects?

Dr. Du Mont. In black and white?

Mr. Dolliver. Yes.

Dr. Du Mont. 525 and 30.

Mr. Dolliver. Thirty pictures per second?

Dr. Du Mont. Thirty pictures per second; yes.

Mr. Dolliver. Are those same standards acceptable for color television?

Dr. Du Mont. Yes, absolutely.

Mr. Dolliver. So from that standpoint, at least, there is no perceptible difficulty as far as having a compatible color television is concerned?

Dr. Du Mont. None whatsoever.

Mr. Dolliver. What is the difficulty about compatibility, then?

Dr. Du Mont. That is a hard question for me to answer.

Mr. Dolliver. That is the reason I asked. I do not know the answer at all.

Dr. Du Mont. I just cannot see the logic in not having it. To me there is no excuse for not having compatible standards. You lose nothing by it, as far as I can see.

Mr. Dolliver. The thing that this committee, I take it, is searching for is the reason for the delay in the public having the advantage of color television. Now, we have been told by witnesses here, responsible witnesses, as you are, that this thing has been developing at least 10 years ago, when color television was transmitted and probably 5 years ago there was a demonstration of it, and at least 3 years ago there was licensing of a system, and we are still without color television on a commercial basis. We want to know what we can do, if anything, or what ought to be done to clarify the situation. We think perhaps the revocation of this M-90 by the NPA was helpful and maybe there is somethting that can be done.

Dr. Du Mont. My personal opinion is that in the industry I certainly do not know anybody that has been trying to hold back television. I know certainly the bulk of the industry would like to see color come as soon as possible, but you have to have a product before

you can produce it. I think it is simply a question of time. I do not know whether it is going to be another 2 years or another 4 years before we have the answers, but I do not think it is going to be tomorrow. I do not think there is any sense of kidding you gentlemen that you are going to have it tomorrow. You can come back in a couple of years and you will find out that this has not happened.

Statements were made in 1948 that color was here. All the FCC had to do was give the permission and color would start right up. Permission was given and what happened? It was a system that could not be used.

Mr. DOLLIVER. Doctor, in your opinion has any tube been developed, in both the dot sequential system and the CBS system?

Dr. DU MONT. Either the RCA tube or the Lawrence tube will work on either system; they will work interchangeably on either system we have been mentioning here.

Mr. DOLLIVER. Then as I understand you, the real impediments to this thing are first the excessive expense to get the color receivers on the market, and second, what to you are obvious imperfections in the receiving set itself.

Dr. DU MONT. In my estimation, it is not so much in the receiving set as in the cathode-ray tube. I think we can handle the set, though it is still too complicated. We would like to see possibilities of simplifying the set by simplifying the standards.

Mr. DOLLIVER. Would that not come after the commercial color television broadcasting commenced? That happened in radio, if I recall correctly.

Dr. DU MONT. It would come down considerably. There is no question about that. But whether it would come down as far as we would like to see it, we are not certain yet.

Mr. DOLLIVER. That also has happened in the broadcasting of black and white.

Dr. DU MONT. Absolutely. I have tried to look ahead. I have tried to not look at these first experimental sets.

Mr. DOLLIVER. Judging from what I know of the industry, the Du Mont Co. has contributed materially to the development of good reception in black-and-white television.

Dr. DU MONT. That is right.

Mr. DOLLIVER. I think, Mr. Chairman, that is all I have.

The CHAIRMAN. Mr. Priest.

Mr. PRIEST. Dr. Du Mont, I want to ask you 1 or 2 questions, because it seems to me that your statement with reference to the size of a set for the Dr. Lawrence tube that we heard about this morning conflicts rather considerably with what Dr. Hodgson told the committee this morning. I understood you to say it would require a much larger set. Do you mean that the area for the diameter of the tube would have to be larger?

Dr. DU MONT. I pointed out in this photograph of the receiver that all this is thrown away [indicating]. In other words, I do not know what size this tube is, but this is all space that is thrown away, so the cabinet has to be much wider than normal and higher than normal. Du Mont used to make black-and-white tubes that way, but we have gone away from it.

Mr. PRIEST. In the testimony this morning, the witness said, "The present model of the large tube is a 22-inch tube. However, designs

already have been completed for a 28-inch tube. What is significant is that the Lawrence tube from front to back is about the same length, or indeed, a little shorter than conventional black-and-white tubes of equal size. This mean that present cabinets can be used for this tube. Competitive models, on the other hand, are substantially longer."

He went on to develop and rather emphasized the fact that it would not mean a bulkier set, as he expressed it. I heard your statement on it, and it was a little confusing.

Dr. DU MONT. What he was talking about was the depth of the tube. He was saying that the set does not have to be deeper than the black-and-white, but it has to be considerably wider and higher. As far as the depth of the cathode ray tube, we can make our black-and-white tubes this long or this long [indicating]. He has decided to make it a little bit on the short size, which requires that he use a lot more power to deflect the beam. To get the best value priced set in black-and-white, we picked the optimum length with the cabinet not too deep, and use the minimum power in the deflection coils. We can change that in anyway and so can he, as far as depth is concerned. He can also put in a rectangular tube as we have in the black-and-white.

I say it simply has not been done, and it takes a while to do it.

Mr. PRIEST. Have you seen this tube demonstrated?

Dr. DU MONT. I saw it some time ago. I do not know whether it was 3 or 4 months ago. I tried to see it recently but it was not set up. I understand it is considerably better than when I saw it. I have not seen it in the past 3 or 4 months.

Mr. PRIEST. Mr. Chairman, that is all.

The CHAIRMAN. Mr. Derounian.

Mr. DEROUNIAN. Dr. Du Mont, I quote from page 151 of Popular Mechanics of March 1953. In answer to a question "When am I likely to be able to buy a television set," you answered:

> Just a rough guess would be 5 years from now. In my estimation, it will be at least a year before the NTSC will be able to submit the system to the FCC. Judging by the speed the FCC has shown in the past, I would be surprised if they decided anything sooner than 3 years after they received it. That makes 4 years.

What I want to know is why do you think it ought to take them 3 years on the average to decide a question because we are interested in that. If they are dragging their feet unusually, we ought to know about it on this committee.

Dr. DU MONT. That is something you gentlemen could undoubtedly help. When I said I was going by past performance, I think with a little assistance that might be lessened considerably.

Mr. DEROUNIAN. Do you think that there is lack of speed on the top level, or do you think the reason they gave as lack of personnel is the proper reason? You know all the agencies tell you they could do a better job with 100 percent more employees, and 200 percent more money, but it is our job to strike a medium there, and see what the trouble is.

Dr. DU MONT. My feeling is with the staff the FCC has, it could be handled much more rapidly than at present.

Mr. DEROUNIAN. That is something we will have to look into. That is your opinion.

Mr. PRIEST. Will the gentleman yield?

Mr. DERIONIAN. I am finished, Mr. Priest.

Mr. PRIEST. Assuming that the Commission made a decision in considerably less than 3 years, would your estimate of 5 to 10 years as contained in this article still stand, or would it depend somewhat on the decision of the Commission?

Dr. DU MONT. It would come down, certainly. If the FCC action takes a year rather than 3 years, I would cut a year off either end. I was trying to take the wide leeway there. Back in 1946, I made a prediction that we would have color television in 10 or 20 years, and I took an awful beating before the FCC for saying it, but here is 7 years and we still do not have it. So my prediction will not be too far off.

Mr. PRIEST. If the Commission should make a determination within 6 months on standards for a compatible color broadcast, then would you care to predict how long after that decision it would be before color television would be generally available?

Dr. DU MONT. After the decision is made, I think it will take at least a year to tool up before sets come out, and then manufacturers will build from that point. I do not think manufacturers can tool up much before a year.

Mr. HINSHAW. If the gentleman will yield, Dr. Du Mont indicated a moment ago that they probably would not even go into it for 2 or 3 years.

Dr. DU MONT. I was taking his assumption that we had arrived at a satisfactory standard. I thought that is what Congressman Priest was talking about. My point is that at the present time I do not think we have it.

Mr. HINSHAW. I gathered from what you said that you did not have it, and you would not produce it whether you got Order M-90 rescinded or not, and the question of whether different standards were set up did not have anything to do with it.

Dr. DU MONT. No.

Mr. HINSHAW. It was a question of the standards of design.

Dr. DU MONT. No. I said at the present time I do not think that in my estimation we have an adequate standard. I do not know whether in 6 months or a year from now we will have it. This question was asked about my 5- or 10-year prophecy. I made certain suppositions that it would be a year before the NTSC submitted its standard. In other words, a year before this thing was settled, and we had something satisfactory. Another 3 years for the FCC to act, and another year for the industry to tool up. On the basis of the question I was asked: if the FCC could act in a year, what would happen; obviously the time could be compressed. But I cannot guarantee that the industry is going to come up with a satisfactory standard in 6 months, a year, or 2 years. I do not know. I do not think the industry has at the moment.

The CHAIRMAN. The longer the hearing and the more questions are asked, the more convinced I am that we need a crystal ball.

Mr. Younger.

Mr. YOUNGER. Just one question. I think you said a while ago, Doctor, that regardless of whether the FCC adopted standards, you as a manufacturer, if you felt that you could not put out a salable and satisfactory receiving set, you would not manufacture it.

Dr. DU MONT. That is absolutely correct.

Mr. HINSHAW. That is the point I got.

Dr. DU MONT. I do not feel that because the FCC sets a standard that we as a manufacturer are obligated to manufacture receivers any more than anybody has to make electric fans.

Mr. YOUNGER. That is the point I want to make clear in the record.

Mr. HINSHAW. You do not necessarily produce anything by setting a standard or rescinding an order.

Dr. DU MONT. Yes.

The CHAIRMAN. That would be true as far as this particular company is concerned, but it might not be true with respect to some other company.

Mr. YOUNGER. That is right.

Dr. DU MONT. That is correct.

The CHAIRMAN. I would be willing to take a chance on an early decision by the FCC, I think.

Mr. Hale.

Mr. HALE. You do not think that the Federal Communications Commission has unduly retarded the development of color television, I take it?

Dr. DU MONT. No, but I think the Commission retarded the development of black and white a great deal. The FCC held it back three and a half years while it debated this color question. I do not think there was any necessity about that. A lot of business was lost.

Mr. HALE. If I understand you correctly, you do think that they unduly retarded black and white television?

Dr. DU MONT. Yes, very definitely. We did not have a new station authorized in three and a half years while this color thing was going on.

Mr. HALE. You have nothing against them as far as color is concerned?

Dr. DU MONT. I do not know as I want to go that far.

Mr. HALE. Dr. Du Mont, what puzzles me is that in the early days of the automobile industry, manufacturers put all kinds of cars on the road and people were willing to pay up to $10,000 or more for a car that to us would appear to be ridiculous. There was a great deal of boldness and experimentation and willingness of manufacturers to take a risk to go ahead with mechanisms which were obviously far from perfect. But that sems to be quite the reverse of the spirit which imbues the color television people.

Dr. DU MONT. I do not think so. I think it is a question of percentage. It is true in the early days of the automobile that manufacturers did sell some at very high prices. But it was not until Ford came along that there was really terrific production. The same thing applies to black and white and it applies to color. About 10 percent of the people will pay a lot of money. But the average person for whom prices should be down just cannot afford expensive sets. Prices must be brought down for him. I do not think there is any difference now from that standpoint. There are some people, up to 10 percent of our population, I would say, who will really go overboard in spending money.

Mr. HALE. I was wondering what would have happened if the automobile industry in its early days had been subject to the jurisdiction of the Federal Communications Commission?

Dr. DU MONT. There would have been a lot slower development, I am sure.

Mr. HALE. Do you think it would have been any better?

Dr. DU MONT. I do not think so, no. It is a different thing. It just happens unfortunately that television is more like a railroad. In other words, if each railroad in this country were built with a different gage track, there would not be a good system. Without standards in television, each station would use a different system, and one receiver could operate only from one particular station. That shows the necessity for standards. It would be a most unfortunate situation.

Mr. HALE. Understand, I am not trying to be facetious about the Federal Communications Commission, because I recognize it has a definite place and serves a necessary purpose, but you have to figure all the disadvantages of a bureaucratic setup against its advantages. Certinly I would say that the automobile industry developed much more rapidly through the fact that it was not subject to any regulatory board. That, however, is only a matter of opinion.

Dr. DU MONT. I do not want to be unduly critical of the FCC. As a matter of fact, if you look it up, you will find from 1946 to 1952, that the advance of the television industry percentagewise has been greater than any other industry in the history of this country. In other words, we had 6,000 telvision sets made in 1946, and last year we had 6 million. The percentage increase in the television industry has been more than autos, phones, and so forth; although we have differences of opinion with the FCC, the television industry has made out reasonably well.

The CHAIRMAN. Mr. Heselton.

Mr. HESELTON. In your annual report, I find this sentence:

> At its current status color television still requires extremely elaborate equipment and considerable simplification must be made before color television becomes commercially practical.

Does that refer to both the receiving sets and the broadcasting equipment?

Dr. DU MONT. It refers primarily to the receiver. We are not particularly concerned if the broadcaster has to spend more money to transmit the program. That is not the problem. But in the case of the 20 million receivers, it is very, very important.

Mr. HESELTON. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Younger.

Mr. YOUNGER. I just want to ask one question. Do you recall the time that it took before for the FCC when they first started their hearings on the color broadcasting before they issued their standards?

Dr. DU MONT. About 3 years.

Mr. YOUNGER. It was about 3 years before?

Dr. DU MONT. Yes, sir. It was about 3 years in black and white, too. That was the reason I chose that time.

Mr. YOUNGER. That is all, Mr. Chairman.

The CHAIRMAN. Any further questions, gentlemen?

Mr. CARRIGG. Doctor, I wonder if we could pinpoint the reason for the fact that we do not have color television. Could you give us your own reason why we do not have it?

Dr. DU MONT. I think the only reason you do not have color television is the same reason that you do not have many things today, that you cannot go to the moon, for instance. I just do not think the

development work of the art has gone far enough. I do not think there has been any attempt by the industry to hold back color television. As far as I, and I believe the majority of manufacturers, are concerned, we would like to see nothing better than color television today. It is a natural development. For example, take motion pictures. There were black and white movies for many years before color came along, and still only about 20 percent of the pictures, I believe, are in color. I think it is simply a question of development, that the art is not ready yet, and that it is a very difficult thing to force.

Mr. CARRIGG. I am wondering if I am mistaken in my recollection of something you said a moment ago, that you thought it was because of the public that we do not have color television.

Dr. DU MONT. I was talking about the system that was standardized upon by the FCC and about the attempt made to sell it. I said the public ultimately decides a question of this type. In other words, you can decide here, we as manufacturers can decide, the FCC can decide, on a color television system, but if it is not a good system and the public does not like it, it is going to die because the public will not buy the receivers.

Mr. CARRIGG. Has the public had an opportunity to decide yet?

Dr. DU MONT. I would not say it had the widest opportunity, but it did have an opportunity, and indicated rather strongly it was not interested in the system proposed.

Mr. CARRIGG. As I understand some of the testimony that has been given so far, the Columbia Broadcasting Co. was in a position where they thought they could give us color television; is that correct?

Dr. DU MONT. That is what they said, yes.

Mr. CARRIGG. Then was not some sort of court action begun by a group in the industry to prevent them giving us color television?

Dr. DU MONT. There might have been others, but RCA was the one that sued.

Mr. CARRIGG. They were the prime mover?

Dr. DU MONT. That is right.

Mr. CARRIGG. As I understand the testimony that has been given here before, they were joined by other members of the industry.

Dr. DU MONT. I think one other member joined, as well as I recall.

Mr. CARRIGG. And then as a result of that injunction we were prohibited from receiving color television at least for a while.

Dr. DU MONT. For a while, and then Columbia won the suit, and was free to go ahead and did go ahead.

Mr. CARRIGG. And then order M–90 came out.

Dr. DU MONT. That was quite some time later. Receivers were put on the market. Color programs were on the air, and CBS advertised the color receivers. I am not sure exactly the number of months it was tried out, but it was enough time to get a very good indication. We have checked very carefully with the dealers that tried to sell it. They were not successful. They could not sell it.

Mr. CARRIGG. That is all.

Mr. PELLY. Mr. Chairman.

The CHAIRMAN. Mr. Pelly.

Mr. PELLY. Would you just amplify the statement that you made regarding the union restriction on giving color films?

Dr. Du Mont. It is not specifically on color. As I understand it, the motion picture companies and the Petrillo union have an arrangement where if the union records for the films such films may not be supplied to television without additional negotiations. That agreement has only been in effect, as I recall, 6 or 7 years, but the bulk of the color films has been made in that period. The television industry has not been able to afford recent releases. We are using films made, generally speaking, more than 6 or 7 years ago.

Mr. Pelly. Is that a detriment to color television in any way?

Dr. Du Mont. I would not worry about it. I think it will probably be cleared up. It is something that must be considered now, but I do not think permanently.

Mr. Pelly. That is all, Mr. Chairman.

The Chairman. Any further questions, gentlemen.

Mr. Williams. Mr. Chairman.

The Chairman. Mr. Williams.

Mr. Williams. I would like to ask Dr. Du Mont a question which might appear a little alien to the question of color television, but I believe I can tie it in. On the subject of these picture tubes, is the industry now engaged in negotiations among itself attempting to arrive at an agreement as to what will be the standard family size screen for television?

Dr. Du Mont. No. In our free economy and with competition what it is, each manufacturer tries to beat the other fellow.

Mr. Williams. I realize that, of course.

Dr. Du Mont. There is agreement only to this extent; tube blanks and so forth are standard sizes, but manufacturers are free to make any size they want. It is just a question of whether the public accepts it as to whether or not they are successful.

Mr. Williams. Will you encounter any difficulty in color television in attempting to expand the size of the screen? Will you lose any picture quality in expanding the size of the screen in color television?

Dr. Du Mont. I do not see any fundamental difference between color and black and white. It should be the same.

Mr. Williams. That is all, Mr. Chairman.

Mr. Priest. I want to ask one question which I realize is not related to this subject altogether, but I have not heard any more about it than a little news story which I read under a Chicago dateline. I want to ask Dr. Du Mont about that reported development. The substance of it was that in a Chicago laboratory, there had been recently developed an adapter whereby television viewers would be able to see either in black and white or color a television picture in three dimensions. I am seeking information.

Dr. Du Mont. It is possible right over our present system to transmit three dimensional pictures without very good quality; and you can use a viewer and see a third dimensional effect. We can do it today under our present system, but I do not think it is satisfactory. We have been manufacturing 3-dimensional television for more than 3 years for the Atomic Energy Commission. It is not secret. It has been published in the papers. That is so atomic scientists can manipulate devices at a distance. They need that third dimension for remote-control equipment used near dangerous operation.

Technically it is not a great problem. The difficulty arises with third-dimensional television in achieving the same quality we have today; we need twice the frequency band, and that throws out the FCC's frequency allocation scheme.

The CHAIRMAN. Mr. Hinshaw.

Mr. HINSHAW. You and your cohorts who have come before us to testify have continuously referred to the fact that the band width for television has been limited to 6 megacycles. Should we start over again and extend that band width to something more than 6 megacycles?

Dr. DU MONT. I hope not. We would have to start from scratch again.

Mr. HINSHAW. Should we?

Dr. DU MONT. I do not think so.

Mr. HINSHAW. Would it improve the quality of pictures?

Dr. DU MONT. It could conceivably improve it slightly, but under present standards with a good set and proper installation you could sit 10 feet away and not be able to tell the difference between it and a set using broader band width standards. It is true that many sets today are made to a price and do not receive the full picture sent by the transmitter. The transmitter sends out a four and a half megacycle picture signal. Many sets today are designed for 3 or 2.8 megacycles, so you do not get a good, sharp picture. But such sets are built to a price, and represent all that many people can afford. But the better sets, with good installation, produce an excellent picture that compares with the motion pictures.

Mr. HINSHAW. That is in black and white.

Dr. DU MONT. That is in the black and white.

Mr. HINSHAW. But if we are to go into color television in the near future or semidistant future, is it not obvious that a wider band width will give us a better picture?

Dr. DU MONT. Let me see if I have that straight. You want to know if you have a wider band width, if the picture will be better?

Mr. HINSHAW. In color television. Will we not receive a better picture with something like 10 megacycles band width than we do with 6?

Dr. DU MONT. You probably will at the present stage of development, but theoretically this NTSC system is supposed to overcome that, and it pretty well does, theoretically. We actually do not yet have the equipment that will realize that. But I think it will be realized.

Mr. HINSHAW. Does that have anything to do with the cost of the set, the number of megacycles in the band width?

Dr. DU MONT. Generally speaking, the wider the band width the more expensive the system. The wider the band, the less amplification you can get at any stage, so you have to have more tubes in the set.

The CHAIRMAN. Are there any further questions? If not, Dr. Du Mont, we are highly pleased with the testimony you have given. We realize that you have spoken with frankness and given us the benefit of your very best thought in the matter. I have, as already stated, given you the privilege of expanding your remarks, and at this time I also wish to announce that it will be appropriate in view of the conflicting testimony that we have had, particularly today, with some that has preceded, if previous witnesses wish to do so at the conclusion

of these hearings, to add to the statements that they have already made, which can be in the form of a reply to statements that may have been made by other witnesses which seem to be in conflict with what other witnesses have previously testified to. This suggestion is made in order that the committee will have the fullest possible information on this subject.

We realize that those who testified preceding others are at some disadvantage when comment is made by subsequent witnesses to the previous testimony. So there may be as clear an understanding as possible, this opportunity will be given to all witnesses when these hearings have concluded, and before the record has been completed.

Dr. DU MONT. Could I just say one more word? I think anything that this committee can do to sift the evidence given and stop the confusion concerning this subject would be a tremendous help to everybody. As you probably know, many industries are affected by television. Of course, we are interested in seeing television go ahead. A lot of these other industries are interested in seeing confusion in this industry, because it slows down the progress of television. Speaking for television, I feel it would be a tremendous help to the industry if you can get these facts together and eliminate some of the confused thinking that is going on on this particular subject of color. Thank you.

The CHAIRMAN. Certainly that will be the hope and intention of the committee. In addition to that, you have spoken about giving assistance to the FCC. Maybe from the questions asked by some it would seem we should prod rather than assist. Whatever may be required, you may be assured that this committee, as I stated this morning, is very anxious indeed to have complete understanding of this entire matter with the objective that the public shall have the benefit of color television at the earliest possible date.

Tomorrow we have a very important witness to appear before us, Dr. Baker, chairman of the National Television System Committee, and vice president of the electronics department of the General Electric Co., at Syracuse, N. Y.

We will adjourn until tomorrow at 10 a. m.

(Thereupon at 3:45 p. m., a recess was taken until Friday, March 27, 1953, at 10 a. m.)

COLOR TELEVISION

FRIDAY, MARCH 27, 1953

HOUSE OF REPRESENTATIVES,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The committee met at 10 a. m., pursuant to adjournment, in room 1334, New House Office Building, Hon. Charles A. Wolverton (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

STATEMENT OF DR. W. R. G. BAKER, CHAIRMAN, NTSC, VICE PRESIDENT, GENERAL ELECTRIC CO., ELECTRONICS DIVISION, SYRACUSE, N. Y.

This morning we have as our witness Dr. W. R. G. Baker, appearing as chairman of the NTSC, who is a vice president of the General Electric Co., and general manager of the electronics division of that company. For almost 20 years he has been head of the Radio-Television Manufacturers Association's engineering department. He is a past president of the Institute of Radio Engineers, and holds the medal of honor of that society for distinguished contributions in the electronics field. Dr. Baker was the chairman of the first NTSC which made a major technical contribution in 1940–41 in assisting the Federal Communications Commission in establishing the standards for our present television service. He was also chairman of the Radio Technical Planning Board which resurveyed the entire field of frequency allocations in 1944–45. Last July at the request of the Secretary of the Army, Dr. Baker led a task committee of civilians and military personnel to the front lines in Korea to survey and evaluate military applications of electronics. Dr. Baker is also the civilian chairman of the Signal Corps Research and Development Council.

Dr. Baker received his B. E. degree from Union College in 1916 and his M. E. M. degree from the same school in 1918. He began as an electrical engineer in 1916 and was managing engineer of the radio department of the General Electric Co. from 1928–30. He was vice president in charge of engineering and manufacturing with the Radio Corporation of America at Camden, N. J., from 1930–36. In 1936 he returned to the General Electric Co. as head of radio engineering, manufacturing, and sales.

We feel highly privileged to have Dr. Baker, with such an excellent background in education and experience, to come before the committee this morning on this very important matter that has been engaging our attention.

Dr. Baker, you may proceed.

Dr. BAKER. Mr. Chairman and gentlemen——

The CHAIRMAN. And, if you have any associates with you whom you wish to introduce, feel free to do so at this time.

Dr. BAKER. Well, I had hoped, Mr. Chairman, that many of the engineers who I had been associated with in the NTSC work would be here. I see a few of them. Some of them I am sure you will recognize.

Dr. Engstrom, Dr. Brown, and Mr. Hodgson, and Dr. Murray.

I think those are the only members of the NTSC that are with us today.

I am appearing here today as chairman of the National Television System Committee. I want to tell you briefly what the NTSC is, how it came into existence originally, and report on the present status of its work on color television. This committee is an industrywide group of engineers. Its membership includes scientists of the highest standing in a number of different fields of technology such as electronics, physics, colorimetry, optics, and mathematics. Membership is open to any technically qualified person who desires to participate. The membership today includes senior engineers from such companies as:

American Broadcasting Co.
Admiral Corp.
Columbia Broadcasting System Laboratories (as observers only)
Bendix Radio Division
Baltimore Sun (Station WMAR-TV)
Columbia Broadcasting System—Columbia, Inc.
Chromatic Television Laboratories, Inc.
Color Television, Inc.
Crosley Division, AVCO
Allen B. DuMont Laboratories, Inc.
Emerson Radio & Phonograph
Federal Telecommunications Laboratories, Inc.
General Electric Co.
General Teleradio, Inc.
Hallicrafters Co.
Hazeltine Electronics Corp.
Hogan Laboratories, Inc.
The Magnovox Co.
Motorola, Inc.
McGraw Hill Publishing Co.
Philco Corp.
Radio Corporation of America
Raytheon Corp.
Sentinal Radio Corp.
Sylvania Electric Products, Inc.
Tele-King Corp.
Tele-Tech
Westinghouse Electric Corp.
Zenith Corp.

The vice chairmen of the NTSC committee are: David B. Smith, vice president-research, Philco Corp.; Arthur Loughran, vice president, Hazeltine Corp.; Elmer Engstrom, vice president, Radio Corp. of America.

The committee is organized into nine panels designated as panels 11 through 19. The chairmen and the scopes of these panels are as follows:

Panel 11: Subjective aspects of color—Dr. Alfred N. Goldsmith, chairman.

Scope: It is the responsibility of this panel to determine, on the subject basis, the efficient distribution of information as between brightness and color. This determination takes into account the sub-

jective importance of the various constituents of color picture. In addition, the panel gives due consideration to the requirement for a satisfactory compatible black and white picture from such a color transmission.

Panel 11–A: Color transcriptions—Dr. Alfred N. Goldsmith, chairman.

Scope: 1. Panel 11–A of the NTSC has been organized "to study and report on methods of recording in color for television purposes, on methods of producing color release prints, and on methods and equipment for the utilization of transmission of color transcriptions."

2. The activities of Panel 11–A are carried forward through a group of committees, the tasks of which include witnessing methods of recording, processing, and utilizing color records for color television transmission. As a result of their studies and conferences these committees prepare:

(*a*) Official reports on their observations;

(*b*) Tutorial or instructional monographs of value to color television engineers, directors, producers, and other network and station executives.

Panel 12: Color system analysis—Mr. D. G. Fink, Philco Corp., Chairman.

Scope: The function of Panel 12, Mr. D. G. Fink of Philco Corp. is chairman, includes the detailed analysis and interpretation of such new technology as may be evolved in connection with the NTSC signal and the preparation of tutorial papers concerning such new technology.

Panel 13: Color video standards—Mr. A. V. Loughren, Hazeltine Electronics Corp., chairman.

Scope: It is the responsibility of this panel to provide recommended standards relating to the complete video signal. As such, it includes the determination of both colorimetric and electronic specifications. The purview of this committee includes the following:

1. Camera-taking characteristics;
2. Gamma characteristics;
3. Color carrier frequency and its phase relation with respect to horizontal synchronizing signals;
4. The color sequence to be used and whether or not it should be of oscillating type;
5. Band widths of the monochrome and color signals;
6. Relative amplitudes of the monochrome signals and the color carrier;
7. Determination of the maximum system amplitude demands at critical colors to enable the determination of picture-to-synchronizing ratios:
8. Specification of radiated signal.

Panel 14: Color synchronizing standards—Mr. D. E. Harnett, General Electric Co., chairman.

Scope: It is the responsibility of this panel to provide recommended standards for color synchronizing signals and the interrelation with normal deflection synchronizing signals. This committee also considers the interaction between the proposed color standards and the existing black-and-white standards in this regard.

Panel 15: Receiver compatibility—Mr. Rinaldo De Cola of the Admiral Corp., chairman.

Scope: It is the responsibility of this panel to insure by actual observations during field tests that the proposals of the panels as executed will result in satisfactory compatible black-and-white receivers including the effect on broadcasting coverage.

Panel 16: Field testing—Mr. Knox McIlwain, Hazeltine Corp., chairman.

Scope: It is the responsibility of this panel to insure by actual observations during field tests that the proposed standards will result in a signal which will satisfactorily operate color receivers and provide the public with service which in color, is comparable in performance to that established by the monochrome standards.

Panel 17: Broadcast system—Mr. R. E. Shelby, National Broadcasting Corp., chairman.

Scope: It is the responsibility of this panel to insure by actual observations during field tests that the proposed standards will result in a signal which can be satisfactorily broadcast by present broadcast transmitters with only minor changes and can be transmitted from city to city by means of existing or presently contemplated intercity program circuits. In addition, the panel analyzes the equipment required at the studio as well as the transmitter from the NTSC color signals as compared with the present black-and-white signal.

Panel 18: Coordination—Mr. D. B. Smith, Philco, Corp., chairman.

Scope: The function of this panel is liaison and coordination between the panels to reduce duplication of effort, and to resolve matters of scope and jurisdiction among the panels.

Panel 15: Definitions—Dr. R. M. Bowie, Sylvania, chairman.

Scope: It is the responsibility of this panel to produce a glossary of terms and working definitions as used in color television and color generally, as required in the formulation of color television standards.

Our committee has for the past 2 years been working on the development of improved standards for color television for submission to the Federal Communications Commission. We believe that our committee, benefiting from contributions made by some 200 engineers throughout the industry, has made a substantial advance in this important field.

Our committee has openly sought advice and assistance from all segments of this industry and related industries. I'm happy to report that we have received the utmost cooperation from all sources.

Progress reports covering all phases of our work as it went along have been widely circulated throughout the industry, and to the members of the FCC and its staff. Since the work has been exclusively of a highly technical nature, there has not been any popular demand for these documents, nor have we made any effort to seek publicity for our work.

Our committee has concerned itself solely with a significant and highly challenging technical problem: How best to achieve the optimum in terms of a color television system. The only persons on the committee and associated with its work are scientists and engineers of special technical qualifications. This has been the only limiting factor with respect to participation, since any interested scientist or engineer has been welcome. The committee has not concerned itself with any phase of production of equipment, nor with considerations involving the proprietary interests of members or companies in the industry. Taking 2 fixed points: (1) The 6-megacycle band width

established by the FCC for this service, and (2) the physiological and psychological characteristics of the human eye—the committee has attempted to evolve the finest conceivable system, one that is not only practical for the short-range public interests to be served, but one which also contains the necessary and vital growth potential for the long-range public interests.

In order to understand the creation and function of this committee, I would like to go back a little into history.

From the time the Federal Communications Commission issued the first television license in 1927 until April 1940, television had led a hectic, dispute-ridden existence. Various technical and proprietary interests had been at private and public odds with each other and the Commission, and chaos was threatened.

Out of a conference which I had at that time with Chairman Fly of the Commission, there came the concept of an industry-wide committee of technically qualified experts with the objective of determining whether from the discord of counterclaims, there could be secured a concord of expert opinion on which the Commission could rely in establishing this monochrome service. (For those of you who would like to go deeper into this period of history, I strongly recommend to you Dr. Fink's book entitled "Television Standards and Practice," to which I am indebted for some of this material.) Such a committee was promptly formed under the title of the National Television System Committee. Though the board of directors of RMA was instrumental in securing the cooperation of the industry, representation was not limited to RMA members.

Within 6 months from the establishment of this first National Television System Committee, 168 members of the committee and the panels had produced reports and minutes totaling 600,000 words, and had devoted 8,000 man-hours to meetings and travel and had witnessed 25 demonstrations of technical matters. Every phase of the television art had received a thorough reexamination, and a substantial concurrence had been reached on all important technical considerations, despite the fact that then, as now, there were conflicting proprietary interests involved. In opening a January 27, 1941, meeting on this subject, Chairman Fly paid the following tribute to the committee:

> This is another example of the best that is in our democratic system, with the best in the industry turning to on a long and difficult job in an effort to help the Government bodies in the discharge of their functions so that a result may be achieved for the common good of all.

The monochrome standards proposed by the NTSC were adopted by the Commission in May 1941, effective July 1, 1941. It is a tribute not only to the concept itself, but also to the thoroughness and soundnes of the committee's work, that those standards—identical today in every material respect—not only permitted the immediate initiation of the service, but also provided within its boundaries the potential necessary for its subsequent incredibly rapid growth. Even today there is still room for growth within the framework of the monochrome standards.

The problems involved in the 1949–50 FCC color hearings were very similar to those which faced the Commission and the industry in 1940. Again, there were proponents of different systems, each urging the technical and commercial advantages of their own systems.

Since it seemed that history was repeating itself, there obviously appeared to be a service which could be performed by organizing a second NTSC. Both in the course of my testimony during those hearings and also in discussions with individual commissioners, I urged that the Commission seek essentially a scientific solution to the technical problem by taking advantage of the 1940 experience and initiating a similar committee study on the color issues.

When it became apparent that the Commission would not request such help, at the direction of the members of the board of RTMA, a second National Television System Committee was organized. As a nucleus we were fortunate in securing almost all of the keymen who had served so well in 1940–41. I emphasize again that participation in this committee and its panels has been held open to any technically skilled person or company representative. While not directly discouraging our efforts, the Commission Chairman was careful not to identify the Commission with the formation or the operation of the committee. In the absence of any request for assistance from the Commission, however, relatively little could be done during the hearings.

As you know, the hearings ended in May of 1950; the Commission adopted field sequential standards in its order of October 1950, and the order became effective July 1, 1951.

A primary objective of NTSC was to attempt to create a practical color transmission which would utilize as a foundation the existing monochrome transmission standards. All interests involved in this issue, including the FCC as well as other system proponents, have unanimously agreed on the desirability of this objective. In the past they have only disagreed on whether—and when—it is possible of attainment.

If it is possible—as we firmly believe it is—to base color on the current monochome standards, then this important improvement in this service can be realized without reducing the value of a single one of the millions of television receivers owned by the American public.

By the late fall of 1950, it became apparent to the NTSC that a desirable purpose could be achieved by undertaking an evaluation of all of the technical advances that had been made since the close of the Commission's hearing in May. This resulted in the formation of the ad hoc committee of NTSC in April 1951. That report, that is, the report of the committee gave real assurance to the engineers of the industry that there were in existence substantially all of the elements essential to the creation of a system of color television having none of the inherent limitations of the field sequential system.

This report was discussed personally with the Chairman of the FCC and with the chairman of the Senate Committee on Interstate and Foreign Commerce. Copies of the report were widely circulated.

It should be emphasized that in all of the work of this National Television System Committee, there has been no thought or weight given to patent positions, past or future. Our committee has been concerned primarily with the development of a scientific concept. However, being conscious of the FCC position with respect to "paper systems," the committee has felt some obligation to determine that there is in existence apparatus capable of translating this system into an operating reality. Beyond this, the committee had had no contacts with respect to apparatus or equipment considerations.

Although the committee has not become involved with proprietary interests, as indicated above, the committee has kept in mind at all times the fact that any proposed standards must, if conceivably possible, be expressed so broadly as to permit the development by individual manufacturers of distinct apparatus capable of performing under those standards. Therefore, when two alternatives were present as a matter of technical substance, all other factors being substantially equal, the committee preferred the alternative which offered the greatest possible scope for individual manufacturers to develop their own versions of apparatus design.

The method used by the NTSC is primarily to serve as a forum for engineering evaluations and a source of inspiration for the undertaking by individuals and individual companies of the solution of problems identified by the committee and its panels. It offers an industrywide body of the top engineers in the profession performing the function of determining on the basis of demonstrated facts, personally observed, when, as a matter of technical judgment, adequate solutions have been arrived at to engineering problems, or when the point of diminishing returns has been reached in the pursuit of a line of scientific inquiry.

The NTSC, as such, makes no inventions; it designs and makes no apparatus. It has no licenses. It holds no patents.

Based on the assurances offered by the 1951 ad hoc committee report, the NTSC proceeded by the methods just outlined to undertake the job of proving the specifications for a practical compatible color system.

This entire effort had just one purpose: To create for the FCC—or Congress—a body of objective, expert opinion which could be consulted on whether this universally desired system was in fact possible of achievement.

The initial objective was to develop our first tentative signal specification as quickly as possible. The panels got under way promptly, each working on its own phase of the problem as it fitted into the developing pattern. By February 1952, we had succeeded in putting together a complete signal specification and were ready for field tests. Preliminary field testing which followed immediately in the spring of 1952 developed that although the NTSC color signals were capable of producing a fine color picture on color receivers and a black-and-white picture of good quality on the majority of sets in the hands of the public, that signal did not produce a satisfactory black-and-white picture on many of the early model receivers still in use. This was a problem which could not have been discovered in the laboratory or by any means other than field tests.

The problem was referred to the proper panel for solution, and we are confident that a complete solution has now been reached.

I have cited this because it is one of the simpler and more easily understood of the various problems that this committee had to detect and solve. At each step we kept the FCC advised of all of the activities of the committee, the problems being encountered, and the progress being made.

By December 1952, we could see that early in 1953 we would have what we hoped would be the final revised signal specification out of the laboratories and ready for intensive testing under actual field conditions.

Since the purpose of these tests was ultimately to satisfy the FCC that a system had been developed satisfactory for use by the public, it seemed to me extremely desirable to have the Federal Communications Commission fully informed and thoroughly satisfied as to the extent and thoroughness of the tests. Accordingly, on December 16, 1952, I wrote to the chairman of the committee, as follows:

GENERAL ELECTRIC CO.,
Syracuse, N. Y., December 16, 1952.

Hon. PAUL A. WALKER,
Chairman, Federal Communications Commission,
Washington, D. C.

DEAR MR. CHAIRMAN: As the work of the NTSC approaches the period of comprehensive field tests and hence unavoidable publicity, I become more and more convinced that both the color television problem directly and the public interest indirectly will benefit if there can be developed on all sides a fresh detached point of view.

I am, therefore, making this personal appeal to you in the belief that you will welcome an approach which offers promise of minimizing personalities, legalistics, and selfish corporate interests.

Since the close of the color hearing in 1950, there has concededly been major technical progress made in this field. Scientists and engineers responsible for that progress have almost without exception participated in the work of the NTSC. There is then readily available to the Commission a means for obtaining the benefit of this advance in the art. Furthermore, there is direct precedent to support such a call on NTSC by the Commission.

I do not propose a formal hearing because there would tend to produce controversially framed issues. Instead, I suggest that the Commission consider inviting the NTSC to make an informal report.

The initial purpose of such a procedure would be purely informational and educational. There would be no commitment involved on the part of the Commission as to whether formal hearings or rulemaking proceedings would or would not follow this informal stage.

The informal nature of the proceedings would permit a high degree of flexibility with respect to fitting the program into the Commission's schedule, and would also permit the Commission to control the nature and extent of any public knowledge. As you know, the NTSC has pursued a course of not making public statements about its work. While this had led in some quarters to a misunderstanding of the nature of the work and its present status, we do feel that we have done all that is necessary when we offer participation to all qualified persons and keep the Commission and the technical interests in the industry completely advised through distribution of our minutes and reports.

I am not able to say definitely when the National Television System Committee would be prepared to present an informal report to the Commission. My estimate would be some time during the second quarter of 1953. The real purpose of the invitation from the Commission at this time and prior to the start of field tests would be that the element of controversy would be eliminated.

I feel strongly that an invitation of this nature from the Commission would elicit maximum value from the work of our committee in terms of balanced, objective, scientific reporting. The initiation of a proceeding designed toward that objective would further seem to me to constitute an act of real statesmanship, an act which would be almost bound to receive warm support from every quarter, including Congress and industry.

I hope that you will not find me presumptuous in the making of this suggestion. I particularly wanted you to know in my opinion that such an invitation from the Commission would be most welcomed and would find instant enthusiastic response. I would not propose to pursue this line of inquiry beyond the point of dispatching this communication to you and I am not distributing any copies of this letter.

Sincerely yours,

W. R. G. BAKER,
Chairman, National Television System Committee.

Chairman Walker's reply stated in effect that no action could be taken by the Commission until a petition was filed under the Commission's Public Notice 65008 of June 11, 1951. I was, of course, disap-

pointed at this response, but at the same time we recognized that the various requirements set forth in that public notice were designed for the protection of the public to be sure that there would be no commercial service inaugurated on the new standards until all aspects had been thoroughly tested. Accordingly, we are now proceeding with the field tests as rapidly as possible and on their successful conclusion we anticipate the prompt filing of a petition with the Federal Communications Commission.

I realize that I have not given you a specific timetable showing when the public will have color. I am told that Mr. Stanton estimated 6 to 18 months from the adoption of compatible color standards based on orderly Commission procedures and assuming successful field tests. He also pointed out that after this there would be a tooling-up period for mass production. This seems a reasonable estimate of the time element.

When you add to this the accepted principle that early sets will be costly, and color broadcasting will be a gradual development, I feel that this supports my February statement to the effect that commercial—and I want to stress "commercial" color television on National Television System Committee standards is not "imminent." The key to that statement lies in the word "commercial."

Now, gentlemen, to summarize: After more than 20 months of work by some 200 top engineers; after countless combinations of elements and possibilities have been painstakingly analyzed and evaluated; after the accumulation of a library of reference material for the engineers of the industry; after hundreds of laboratory tests and experiments in scores of plants, the National Television System Committee is unanimously convinced that under its supervision there has been prepared a set of standards capable of producing a superlative system of color television—a system which is completely compatible with the receivers now in the hands of the public—in fact, produces a superior monochrome picture as well as a superior color image. Not until the current field tests are completed can our hopes be finally confirmed. You may be interested to know the thoroughness which has gone into the planning of these current field tests, as well as something of their nature. This is the document which lays out the procedures to be followed. Without taking an undue amount of your time, I'd like to read portions of the material. I'll be glad to furnish you with copies of this document.

I would like to read a portion of this just to indicate the comprehensive character that we plan for the field tests.

First, we are making extensive tests with regard to flicker. That is a rather elaborate test and takes in about three sections of the proposed field tests. And then we propose to examine carefully the question of brightness and contrast. The question of registration will be thoroughly considered as will color breakup; color fringing; color fidelity; resolution and picture texture.

We will have to examine very carefully the susceptibility of this system to interference, either man-made or from some other radio service.

We will have to examine carefully the adequacies of the synchronizing methods which we propose and we will have to make very con-

siderable tests with respect to fringe area operations—that is reception of this color system some distance from the color transmitter; and we will have to look into the sound quality and the transmission vagaries; that is, what is the extent of propagation of the color system as compared with monochrome.

I understand you plan to see a demonstration based on National Television System Committee standards within the next few days. I believe I can promise you a rewarding experience. But that will not mean that the National Television System Committee is satisfied. Thorough field testing—properly insisted upon by the FCC—must be completed on every sensitive phase of the specifications. Only then can the National Television System Committee be satisfied that its job is done.

At this stage the National Television System Committee makes the following recommendations:

1. We strongly urge that your committee continue your greatly appreciated interest in this subject of color television.

2. That the Federal Communications Commission formally recognize the existence of the National Television System Committee, and lend its active support to the National Television System Committee program.

3. And we feel this is exceedingly important—that nothing be done to interfere with completion of the current field testing program.

4. That the FCC relax its present restrictive policy in order to permit and encourage earliest and widest broadcasting of the proposed National Television System Committee signal on an experimental basis.

A number of the transmitters, gentlemen, that are now on the air broadcasting or capable of broadcasting color are limited to operations between 1 a. m., and 7 a. m., in the morning. It makes it very difficult not only for the engineers to make their tests, but it practically prohibits, of course, any reaction from one looking at a black and white receiver and receiving color transmission in black and white and we would urge that perhaps in the morning hours, say from 7 to 12 those transmitters that can operate on color be permitted a reasonable period to operate. We are not asking for a whole half a day—a half hour, or three-quarters of an hour, or an hour would be much better than it is at the present time.

5. That upon satisfactory completion of the field tests the National Television System Committee color standards be adopted by formal order of the Commission based on procedures similar to those followed by the Commission in establishiing monochrome standards in 1940–41.

In the meantime, the National Television System Committee will continue working diligently and openly at its tough, challenging task: insuring that the American public get the best conceivable color television system as soon as possible at a minimum investment.

Thank you.

The CHAIRMAN. Dr. Baker, on behalf of the committee I want you to know that we greatly appreciate this report together with the recommendations that have been made by you on behalf of the committee of which you are chairman.

As you have progressed with your statement setting forth to us in such detail the care, the consideration that has been exercised by

your committee in this, as you term it, tough but important task, I feel that the words uttered by Mr. Fly, Chairman of the Federal Communications Commission on January 27, 1948, to which you have referred are as appropriate today as they were when he uttered them. He said:

"This is another example of the best that is in our democratic system, with the best in the industry turning to on a long and difficult job in an effort to help the Government bodies in the discharge of their functions so that a result may be achieved for the common good of all."

Certainly during the years that have elapsed, this committee of which you are chairman, has given unquestioned evidence of a very keen desire upon its part to accomplish something that would be worthwhile to the public and, stripping your work from all thought of commercial advantage to any one individual or set of individuals until there had been a completion of the work and the attainment of the objectives that were set in your committee fully achieved.

The recommendations which you have made are particularly helpful to this committee.

It will be realized that this committee does not have knowledge that would enable it of itself to handle a problem as technical as this. We do have a responsibility. Consequently, it becomes necessary for the committee to have the benefit of services, of testimony of individuals who are competent and who have knowledge of the subject in its technical phases, such as that which has been given to us by those who have appeared before the committee during the week of these hearings.

Your committee, over a period of years has given that service that is so highly commendatory that it would be difficult for me to find words to adequately express the appreciation of the high purpose that has guided and directed your committee through all these years of trial and error; sometimes undoubtedly tribulations; sometimes success, yet, you have continued to persevere.

I feel that your committee has performed a great and outstanding service to our country and its people and I wish to assure you that there can be no finer recognition of the fine work that has been done by your committee than for this committee to consider carefully and well the recommendations that you have made and insofar as it has jurisdiction and power to support and sustain you in the recommendations that you have made. They all seem so reasonable. They all seem so logical, and certainly they come with force to this committee, because of the quality of the committee that has given the study and made the recommendations. I hope that we can arrange, insofar as it may be within our authority, to see that there is the greatest cooperattion not alone from congressional committees, but from agencies of Government, that your statement indicates you feel is so necessary and so proper.

In that connection I wish to say that it is the intention of this committee to have before us on Tuesday next the chairman of the Federal Communications Commission. Now that we have heard from those so qualified to speak during this week of hearings, we feel that it is most appropriate to ascertain from the FCC the extent to which it can and is willing to cooperate.

This committee, as I have previously said, is sincere and anxious to bring this great new development to the benefit of the people of this

Nation at the earliest practical time. We feel that you have made a great contribution not only in the work which you have done as chairman of this important committee, but also in bringing to the committee today this report of the activities of your committee.

We sincerely thank you and the other members of your committee.

Dr. BAKER. Thank you, Mr. Chairman.

The CHAIRMAN. Are there any questions?

Mr. DOLLIVER. Mr. Chairman.

The CHAIRMAN. Mr. Dolliver.

Mr. DOLLIVER. Dr. Baker, I join in the encomiums that have been given by our Chairman. I think you have done a remarkably fine piece of work in the National Television System Committee. Certainly on the basis that you have described we can ultimately have successful color television broadcasts, that may be carried on on a sound scientific basis within a relatively short time.

So, I think that we cannot overemphasize the importance of the work you have done.

Perhaps the question I am about to ask is outside of the purview of the work of your committee. But actually, I am very much interested to know if television receiving sets, capable of receiving the color signal which you say has now been pretty well perfected, have also been perfected to the point where it is possible for us to have commercial color television broadcasts?

Dr. BAKER. Well, sir, at field tests which occurred last week, there were color sets from 18 different manufacturers. It is true that you would have to term these sets prototype receivers, but the fact is that the receivers were there and operated very well and indicates the engineering that is pertinent to the color receiver is well along and I would think that there would be no question that the industry has the engineering ability to produce receivers when the color television commercialization takes place.

Mr. DOLLIVER. I understand from what you said that the standards that you have developed are not so circumscribed and so detailed but that a variety of sets may be produced and there will be commercial competition as to the manufacture of receiving sets?

Dr. BAKER. That is absolutely true, sir.

There are two things which the NTSC must give great consideration to. First, that the standards are so broad that they do not influence the equipment design; that is, the perimeters of the standards are such that every engineer has the freedom of design of equipment which is greatly different from every other engineer, but would still be within those standards. That is the first thing that we have to be careful of.

The second is that we do not make the standards so restrictive that they do not permit the advancement of the art as the technology of the science grows, and those two limitations we believe are adequately taken care of in the standards that are now in the process of being field tested.

Mr. DOLLIVER. As we are all aware, the Federal Communications Commission some years ago issued a license to the field sequential system of color broadcasting?

Dr. BAKER. Yes, sir.

Mr. DOLLIVER. In the work that you have done in your television system committee has consideration been given to that fact, and do

your standards include the possiblity of using the system that has already been licensed?

Dr. BAKER. Well, you will remember that in order to form a platform from which the NTSC could start to work I established an ad hoc committee which objectively studied the whole technology of the color television which would, of course, include the sequential system. As a result of their findings and confirmed by the further work of the NTSC, the present standards do not consider the sequential system as a desirable system.

Mr. DOLLIVER. That is the field sequential system?

Dr. BAKER. That is the field sequential system.

Mr. DOLLIVER. Well now could you explain to us laymen in rather simple language, on what basis; what was the fundamental basis of the transmission of color television under the NTSC standards?

Dr. BAKER. Yes, sir. Let me first say, as you, I believe, have already been told, that the field sequential system involves a transmitting frame which shows the particular color of the picture in either red, green, or blue. I mean that is all transmitted at one time. First, we will say, the green, and then the red, and then the blue, the theory being that that can be transmitted sufficiently fast to fool your eye.

The field sequential system, as has been presented, as a definition takes resolution or detail of the picture line, 50 percent of the system that is proposed by the NTSC.

In addition, with the present state of technology, at the time that that system was proposed there was required a rotating disc which is divided into segments—one segment being green, one blue, and one red.

The disc in general must be twice as large as the picture to be presented to the consumer. That means, if you are going to present a 12-inch picture, the disc would be 24 inches in diameter; if you are going to produce a 20-inch picture, the disc would be of the order of 40 inches in diameter, which makes it rather impracticable to utilize that system in the living room of the consumer.

The other disadvantage of the CBS system, or the field-sequential system, rather, is the fact that it is a so-called noncompatible system. At the time of hearing there were in the order of 7,000,000 television receivers, receiving black and white, in use. There are now somewhere between 22,000,000 and 23,000,000. But even if the field-sequential system had been exploited commercially at the time of the hearing those 7,000,000 receivers would have been unable to receive a color transmission in black and white and while it is theoretically possible to convert one of the receivers in your home so that it would receive the field-sequential color in black and white, such conversion would be impracticable and uneconomic.

Therefore, the ad hoc committee in the NTSC looked around for a system which would permit full compatibility of the black-and-white receiver in your home and in mine and when it did that, it looked at everyone's system, because the NTSC has no pride of ownership. It is looking for just one thing: What are the technical facts, and what is the best system? A system which will permit the engineers to provide the greatest diversity of instrument, that is, apparatus, which goes in your home and mine and a system which will permit the greatest future growth of this new art.

When the engineers did that they conceived an idea which was new—new in its application to color television and novel, but it was not new in the art of printing. In the art of colorimetry it was not new. It had been developed. These engineers took this conception and applied it to color television. Basically it is this: In order to present to you and me a clear picture, we have to do three things. We have to give a brightness of the picture; we have to transmit the various hues, that is, the various colors, and we have to transmit for every element, the degrees of saturation, that is, the amount of white that is mixed in with a particular color.

Previous to this time, and stemming to some extent from the philosophy of the field-sequential system, the plan had been to transmit individual areas, very rapidly, in red, green, or blue. When you transmitted them you transmitted all three characteristics. You transmitted brightness, hues, and saturation all at one time, which is one way of doing a job, a creditable way; but there was another way, which was an improvement.

I will not go into the details of the improvement, but it was a step in advance and it was this: One of the most important things in looking at any picture, whether it is black and white, or color, is the brightness of the picture. The acuity of your eye is such that the brightness of the picture is the most important basic element that gives you the detail of that particular picture.

Now, therefore, if you would take a brightness picture, which is a straight black and white, and if you could color that black and white then your eye would have the advantage of the brightness which is the basic important characteristic and it would also get the various hues and the various saturations, depending upon the green, blue, and red elements.

So what the NTSC standards propose is that we transmit a brightness-characteristic picture—that is, we transmit really a monochrome picture and on this monochrome picture or on its carrier, that carries the monochrome picture, we transmit other carriers which carries the information, the common information being the hue and the saturation, so really what we do in your homes is first put a black-and-white picture in front of you and then we paint in the color. Of course, we do it so fast that you cannot see it. But that is actually the basic philosophy of the standards of the NTSC system and that is the philosophy which has the complete approval of the NTSC.

Actually, when the NTSC reaches into every laboratory of every company, what it does is to lift from those companies and laboratories the things that it wants. There is no name for this system. There is no name for these standards which is connected to any personal commercial entity at all. It is NTSC standards, and that is why our engineers in the NTSC have no interest in patents. They have no interest in anything but the best system.

Mr. DOLLIVER. You say that the signal is first sent out in black and white and then you paint the color on?

Dr. BAKER. It is all done at the same time.

Mr. DOLLIVER. It is all done at the same time—simultaneously?

Dr. BAKER. I only broke it apart in order to explain the situation; but it is all done simultaneously and all done so fast, of course, that you cannot see the painting.

Mr. DOLLIVER. Thank you. Mr. Chairman, that is all.

Mr. PRIEST. Mr. Chairman.

The CHAIRMAN. Mr. Priest.

Mr. PRIEST. I am sure that all of the committee is very much interested in seeing that field tests of the NTSC program or system go forward as rapidly as possible.

In your statement you made this comment in your point 4 on page 20:

> 4. That the FCC relax its present restrictive policy in order to permit and encourage earliest and widest broadcasting of the proposed NTSC signal on an experimental basis.

Just what are those restrictions at this time?

Dr. BAKER. The basic restriction, sir, is that some of our transmitters—the RCA transmitter in New York, for example, and the Philco transmitter in Philadelphia, have to operate in general between 1 a. m., at night, and 7 a. m., in the morning, because they are commercial transmitters.

In Syracuse we do not. We have a separate transmitter which is used for that purpose.

It would be extremely convenient for the NTSC if the FCC would permit us to broadcast maybe 1 hour in the morning from 8 to 9 or something like that.

We recognize that the request is perhaps a little extreme and we recognize that if we got that transmitter into trouble we would have to do something immediately; but our point is that if we are right—and we think we are—we can only tell it by the field tests and if we are right and the transmitter broadcast a compatible signal, then you in your home, looking at a noncolor receiver would in fact not know we were broadcasting in color, so that we gain a secondary advantage. If you do not complain about your receiver, or your reception, then the compatibility is in fact proved.

So that we would like some leniency in that area.

I must say, to be fair, that in the case of specific requirements, the FCC have given us 15 minutes at stated intervals for certain periods of time; given permission to do that. We would like it extended.

These tests are very elaborate and very trying, and it is difficult to make tests in 15 minutes or something like that. Some of the tests take a matter of hours to make.

Mr. PRIEST. Now, Dr. Baker, also on that same page, and closely related to it is this:

> 3. That nothing be done to interfere with the completion of the current field testing program.

What might be done to interfere with it? What are the things you fear, in other words?

Dr. BAKER. Well, if for example all of a sudden, the FCC would say the NTSC has an acceptable system of color television and therefore it is commercially licensed, that would be the thing that I would fear. I cannot stress too strongly the need for a thorough examination of the scientific points of this system. Sir, you are setting standards which last for a lifetime or more than a lifetime. Things happen—and I think that the NTSC is made up of the best engineers in the industry—but they make mistakes. There is a great deal of difference between theory and practice and we in the laboratories and on pieces of paper, can lay out beautiful theories which can be exploded by actual experimentation. The one that I mention here, where we

thought we had the system all wrapped up and then found that the earlier receivers would not receive.

Now, it would have been a very easy thing for the NTSC to say, "Well, what do we care? They were built a long, long time ago. But, it did not seem to the NTSC that that was an equitable thing to do. The man bought the receiver. He had a right, in our opinion, to be able to use it as long as it would work, and we should do nothing which would deprive him of that receiver. So that is why really we added a whole year to our study, just to protect a few hundred thousand receivers; a few hundred thousand individuals—and that is why we did that. So, we wanted it thoroughly tested.

Mr. PRIEST. Thank you.

Mr. YOUNGER. Will the gentleman yield?

Mr. PRIEST. I will yield.

Mr. YOUNGER. On that same point, it strikes me if the FCC does not relinquish that restriction that would be absolutely thwarting the field tests, because you have to get field tests during the times and under the conditions of normal broadcasting periods, and if you do not have that under normal broadcasting conditions, as to atmospheric conditions and everything else then how are your field tests to be completed?

Dr. BAKER. Well, sir, they cannot be 100-percent completed except we have in Syracuse a transmitter which is not used commercially for commercial broadcasting and we can get some information from that; but, the proper tests must be made under actual conditions.

Mr. YOUNGER. That is what I point out. Now, if they do not relinquish those then they are not cooperating.

Dr. BAKER. Well, that makes it difficult for the NTSC.

Mr. YOUNGER. That is all.

Mr. PRIEST. That is all.

Mr. O'HARA. Mr. Chairman.

The CHAIRMAN. Mr. O'Hara.

Mr. O'HARA. Dr. Baker, I noted from your testimony that the so-called black-and-white system that the regulations of the FCC were laid down back in 1940–41.

Dr. BAKER. Yes, sir.

Mr. O'HARA. Those same standards, I believe, exist today for the broadcasting of the so-called balck-and-white system; is that correct?

Dr. BAKER. Yes, sir; that is correct.

Mr. O'HARA. And it took some years to develop?

Dr. BAKER. Yes, sir.

Mr. O'HARA. I presume that the war interfered, but it took some years to produce and manufacture?

Dr. BAKER. Yes, sir.

Mr. O'HARA. And it took some years for the distribution of sets, and for the buying of them by the public, with the conditions that we had and the extent to which the public was interested in black and white.

Now, was that development delayed there, in your opinion, by any undue action on the part of the industry, the FCC, or any other conditions; or was that a rather gradual, normal growth in this science?

Dr. BAKER. You are talking about——

Mr. O'HARA. About black and white.

Dr. BAKER. Black and white?

Mr. O'HARA. Yes.

Dr. BAKER. I think that the only delay—the only thing that delayed the developmentation of black and white from the viewpoint of the consumer was World War II. That absolutely, as you know, closed us down in the commercial exploitation of black and white.

But, the thing, right after the war, as you also recognized, the industry blossomed out and that blossoming would certainly have occurred before if it had not been for the war.

Mr. O'HARA. Now, in regard to the operations of your NTSC, does your committee work with the standards established from the very beginning, or has your committee shifted from one set of standards to another in the course of your study of color television?

Dr. BAKER. We have changed. First we laid out what theoretically looked to be the idealistic standards and then we began to make tests in laboratories to prove out the elements and the pieces and parts, so that I will have to answer you, sir, in saying, as your development plans progressed, we modified the standards in considerable detail as the engineering was proven. So that, in other words, we had to prove every step. If it didn't prove, we had to make some changes and that was evidenced by the fact that we took another year to make certain that the early black-and-white receivers would synchronize on NTSC standards as now proposed.

Mr. O'HARA. Now, it is quite understandable to me that you would shift your standards. As that shifting was done, was there protest by one company to the standards proposed by others or were there objections to shifts incorporated in your standards, improvements incorporated that were suggested by one company, by another company?

Dr. BAKER. The operations of the NTSC does not involve a company. A company has nothing to say about it. It depends entirely upon the person who is assigned the responsibility. Take a specific example. There is a problem on synchronizing, for example, they have to determine the character of the synchronizing. That information is pooled. Let me go back.

First panel 13 laid out what they thought was the best color standards; signal specifications and every element, and this was broken up in pieces and assigned to panels. A piece of that problem was the synchronizing characteristics. That was assigned to a panel who was responsible for that, Mr. Harnett. They started to work. I believe they changed; that panel changed that synchronizing policy either 3 or 4 times. They changed it of their own free will and accord as they found their mistakes, until finally they now have a synchronizing pulse, which they now say is right.

So far as the field tests indicate, that panel is right, but if it is wrong, if the synchro pulse does not prove out, then they will have to change it; but, sir, no company has any influence on that part of the operation. That is a crew of engineers who are separated from their company with respect to that synchronizing pulse.

Mr. O'HARA. Well, the point that I am making, doctor, is that in this study which your group is making, naturally the developments of one company or the engineers of one company may affect your decisions.

Dr. BAKER. That is right.

Mr. O'HARA. But it is the work of the engineers and not of the companies, so far as you people are concerned?

Dr. BAKER. That is absolutely true, sir. It is true that in many research laboratories and development laboratories companies by themselves are carrying on projects which they think are right with respect to color. They permit us to look those things over. If out of if we find anything we want, we may lift it, any idea, or circuit, or something, and we just lift it out of there and take it.

Mr. O'HARA. Do you think, using this merely as a simple illustration, do you think—take the development of a tube—there has been 1 outstanding tube, or 2, or several, 50, or a hundred of them. What do you think of that?

Dr. BAKER. Well, there has not been a hundred or 50. There are at the present time probably at the most 3 tubes that hold promise. The tricolor tube developed by RCA was certainly the first practical tube that an engineer would look at and say that "This has possibilities."

I want to say that I think that RCA has done a most splendid job in the development of that tube and it probably—and this is my opinion—is the tube that is furtherest advanced today. The second type of tube is that produced or proposed by the Chromatic Laboratories, and that tube also has very attractive features.

So, those are the 2 possibilities, and then there is also the opportunity in engineering to take pieces of 1 type of tube and pieces of another type of tube and put them together and make still a third tube, and that is going on also.

So that I think you can say that you have the potentialities of three types of tubes today, but the tube that undoubtedly is in advance is he tricolor tube of the RCA.

Mr. O'HARA. One other question. Certain terms and conditions must be met which were established by the Commission in a color television system?

Dr. BAKER. Yes, sir.

Mr. O'HARA. That might be proposed to the Commission?

Dr. BAKER. Do you mean by that, sir, what you need to do in order to ask for a hearing?

Mr. O'HARA. That is right.

Dr. BAKER. Well, there was——

Mr. O'HARA. I mean briefly, Doctor.

Dr. BAKER. I would like to give you that, because it has been a relatively troublesome factor to the NTSC, that is, the requirements that the Commission insists must be met, and I have it right here, and I would like to read you 1 or 2 of the things that have to be met, that have been bothering us. This is FCC Public Notice No. 65008, published June 11, 1951, and is a statement by the FCC on color television, and it says—in general the Commission does not close the door on further experimentation. It states the things which you should do in order to petition. It outlines the steps as follows. The first step is an appropriate petition which must be filed requesting rule-making proceedings with respect to color television standards.

Now this, of course, is the condition that exists because there has been accepted a set of standards covering the field sequential system.

Item 4 in this puts this sort of a burden on the NTSC or anyone who wishes to file. It says:

4. It—

Meaning the system, the proposed system—

must be capable of operating through receiver apparatus that is simple to operate in the home, does not have critical registration or color controls, and is cheap enough in price to be available to the great mass of the American purchasing public.

That is quite a task for the NTSC to say that all those characteristics can be met. Further it says:

5. It must be capable of operating through apparatus at the station that is technically within the competence of the type of trained personnel hired by a station owner who does not have an extensive research or engineering staff at his disposal and the costs of purchase, operation, and maintenance of such equipment must not be so high as unduly to restrict the class of persons who can afford to operate a television station.

And it goes on to say:

6. It must not be unduly susceptible to interference as compared with the present monochrome system.
7. It must be capable of transmitting color programs over intercity relay facilities presently in existence or which may be developed in the foreseeable future.

Now, many of those things the NTSC can say. We can say we can transmit over intercity relay facilities. We can say, in our opinion, this system does not require a physicist to operate the transmitter. That would be only our opinion.

We think that this requirement, in order to file for a new system of color television is too restrictive, particularly in view of the fact that the field sequential system has not been economically developed.

Mr. O'HARA. What is your prognosis as to what and when the public may generally have color television?

Dr. BAKER. Well, of course, that is a $64 question and I can only give you the horseback estimate of my own.

I am not now speaking for the NTSC, because I do not believe I could get the engineers to agree on anything I said with this respect.

I think it will take from 4 to 6 months for the NTSC to completely satisfy itself that it has a system or it has standards rather which it will back up, and I would like to elaborate on that point just a little bit.

First, when you are laying out standards which cover a lifetime, the engineers feel that they have to be very careful. They were successful in the case of the monochrome. Actually I think that they do not want to stretch their luck twice. They want to be awfully sure this time.

So that if you say it takes 6 months, or 4 months, or you can pick any date there you wish, for us to complete our tests, then there should be some form of a hearing before the FCC in order to make it orderly.

Whether the FCC would want to have a formal hearing or whether they would want to invite the NTSC to present its technical story and then base it on the presentation of that technical story the FCC would determine whether or not in fact a formal hearing was necessary, I do not know. I do not know how long that will take, and then if the FCC were to make a decision, if it took 6 months for us to complete our tests, it might take another 3 months to make all arrangements for us to present our information; and it might take another 3 or 6 months for the FCC to deliberate on this matter, and

in fact, if another hearing was required, it would take all of that time, before there was commercialization.

So, I would think in the normal course of events we could expect commercialization within a period of from perhaps 9 months to 15 months, or something in that order.

Now, many of those things could be telescoped, of course, in which case you might get it cut down to 6 months. I do not know. I think that the critical thing, sir, is to let us find out if we have something first without a question of doubt; let us find out, because unless we are certain of that anything that you do will collapse because the base is unsound.

That is really my great plea. Let us find out if we have really got it.

Mr. O'HARA. That is all, Mr. Chairman.

Mr. HARRIS. Mr. Chairman.

The CHAIRMAN. Mr. Harris.

Mr. HARRIS. Doctor, I assume when you speak of the committee's standards, you have reference to such matter as signals, transmitting characteristics, the reaction of the human eye, and transmitters and receivers. Is that right?

Dr. BAKER. That is correct, sir.

Mr. HARRIS. There is no particular set of standards such as you would outline as such?

Dr. BAKER. Well, sir, the NTSC has standards, plus a signal specification which encompasses all of the factors that you have stated.

Mr. HARRIS. Those standards you referred to—I want to get this clear in my mind since standards have been discussed here throughout the hearings—are standards that can be outlined as 1, 2, 3, and 4, that can be put on paper?

Dr. BAKER. Yes, sir. They are similar to but not the same as the standards for monochrome. Our final product will be a list of standards which are comparable to the monochrome standards, and they will apply to black and white.

Mr. HARRIS. Has this list of standards been presented to us here?

Dr. BAKER. I do not think it has, sir.

Mr. HARRIS. Do you have such a list of standards?

Dr. BAKER. Yes; and I can see that you get it.

Mr. HARRIS. Is it a long one?

Dr. BAKER. No; it covers about 3 or 4 pages, and I will see that you get a copy.

Mr. HARRIS. There has been so much discussion about these standards, Mr. Chairman, that I think it would be helpful to have them in the record.

The CHAIRMAN. How soon will you be able to do that, Doctor?

Dr. BAKER. Tomorrow.

Mr. HARRIS. Thank you.

Dr. BAKER. They have all been prepared. They have been sent out to the industry. I think that we have distributed, with the signal specification and the others, something like six or seven hundred copies to everyone in the industry, so that they may know and so that their engineers may know what we are recommending so that as their engineers consider the design of color television transmitters, or receivers, they can be guided by the probability that these may be the standards.

Mr. HARRIS. I suppose that it has probably been considered such an academic question here that no one thought about presenting them to us.

Dr. BAKER. I do not think it was that, sir. I think the fact that you run into a very considerable amount of technical detail, which we did not think you would want to take the time to discuss is probably the reason; but we will see that you get a copy.

Mr. HARRIS. Yes. The purpose of my question was to find out about this. You have referred to your monochrome standards.

Dr. BAKER. Yes, sir.

Mr. HARRIS. Now, does this list of standards include the monochrome standards?

Dr. BAKER. No; the monochrome standards, sir, apply to black and white television, the system which has been in commercial use now for a number of years.

Now, the color standards are a separate set of standards.

Mr. HARRIS. Does it include a part or all of the monochrome standards?

Dr. BAKER. No; it does not include all of them. It includes certain things for example, it says that color will use 525 lines; 60 fields; 30 frames; 6 megacycle bands because those things are comparable in both, and you see, they have to be, because we say that a color system is a compatible system and it must be shown on black and white receivers in black and white, the color transmission, so that the color standards of the system, if it is to be used with a monochrome receiver has to be the same, to fit into the monochrome standards.

So that the answer to your questions is yes, certainly the monochrome standards are lifted over into the color area.

Mr. HARRIS. Now, you said I believe the Commission adopted the committee's recommendations on monochrome standards.

Dr. BAKER. That is right, sir.

Mr. HARRIS. Is your committee responsible for the monochrome standards?

Dr. BAKER. Well, not this particular committee. There have been two NTSC committees.

Mr. HARRIS. Yes; I know.

Dr. BAKER. The first one was responsible for the monochrome standards, and the second one we are now working on will be responsible for the color.

Mr. HARRIS. But, the second committee is composed pretty much of the same companies, and same personnel, technical personnel and engineers, and so forth, that the first was.

Dr. BAKER. That is right; to a very large extent, that is true; as I said in my presentation, we were fortunate in using in the second NTSC many of the engineers who had this experience of the first NTSC committee.

Mr. HARRIS. And this committee was the one developed the system of standards, monochrome standards?

Dr. BAKER. That is right.

Mr. HARRIS. And you presented that to the Commission?

Dr. BAKER. Yes, sir.

Mr. HARRIS. The Commission adopted those standards?

Dr. BAKER. Yes, sir.

Mr. HARRIS. Now, was there any controversy whatsoever within your committee or within the industry on the monochrome standards?

Dr. BAKER. No, sir. Let me correct that. You cannot get a group of engineers together without having controversy.

Mr. HARRIS. Well, I can appreciate that.

Dr. BAKER. But, by the process of reasoning and study they finally came to a point where we had a unanimous decision and presented it to the NTSC.

Mr. HARRIS. Now, you come to your committee's system; that is, standards on color television.

Dr. BAKER. Yes, sir.

Mr. HARRIS. Did you have wide differences of opinion in your committee?

Dr. BAKER. We certainly had them in the beginning, sir; but gradually the points of difference have been worked out.

I had prepared another statement and I would like to read, if I may, a statement which I wrote to Senator Johnson, in 1950, which covers some of the points that you bring up. I said:

> We do not believe that a public hearing is the most conducive place for an exchange of information and technical opinion. Engineers and scientists tend to forget their pride in their own ideas or research when they are joined in conference with many others whose technical competence they respect.

And, that is the point that I would like to make; if you can get a group of engineers who will remain engineers, and scientists who will remain scientists, and study a technical problem, you will get an answer that is sound, and that is what has happened in the color TV.

Now, these men are all individualists. They appear on the NTSC as individualists, and therefore they express their opinion in no uncertain words; but they are dealing with people whose technical abilities they respect and, therefore, you can always get a meeting of the minds.

Mr. HARRIS. Doctor, is Columbia Broadcasting System on your committee?

Dr. BAKER. CBS—well, I will have to say—let me answer first. The manufacturing organization is on my committee as a voting member. The laboratories are on it in the capacity of observer.

When the NTSC was first started, I asked, as chairman, CBS if they would not join. They refused. Later on I asked them again if they would join and they refused. And then, a third time, after a little interval, I asked them again, and they did.

So, the CBS is a part of the NTSC from the manufacturing unit. The laboratories are on as observers.

But, whether they would join or not, they would get a copy of all of our findings. We want to spread that information as wide as possible.

Mr. HARRIS. Now, did they become members of your committee before or after these hearings ended in May 1951?

Dr. BAKER. After.

Mr. HARRIS. After.

Dr. BAKER. Oh yes; after that.

Mr. HARRIS. In other words they did not become members of your committee until the Commission had rejected your recommendations for standards?

Dr. BAKER. Well, no. Let us get this straight. We have not submitted to the Commission any standards covering color television.

The sequence of events was about like this. The NTSC was formed just prior to the closing of that hearing. After that hearing, there was put in place the ad hoc committee to study the basic technology. They made their report and then the NTSC was completely reorganized to conform with the ad hoc committee's report.

Then this NTSC started to work.

Right at that time CBS were asked to come in, and that was the first time, and they refused. These dates are all available in the record. I just do not happen to have them.

Subsequently they were asked again and then I guess perhaps 6 months ago is the third time I asked them, when they came in.

Mr. HARRIS. Well, the point is that the Commission did adopt the field sequential standards in its order of 1950?

Dr. BAKER. Yes, sir.

Mr. HARRIS. And your committee did not agree with that decision?

Dr. BAKER. That is right, sir.

Mr. HARRIS. Well, then, let us just put it another way from the way I did a moment ago as to the action of the Commission. I was trying to get the point whether or not the Commission's action coincided with the years of work of your committee. Now that leads me to this question.

Obviously the efforts of your committee has been toward the objectives of developing a compatible color television system.

Dr. BAKER. Yes, sir.

Mr. HARRIS. That is your view, is it?

Mr. BAKER. Yes, sir.

Mr. HARRIS. And that is in conflict with the action taken by the Commission.

Dr. BAKER. That is true, sir.

Mr. HARRIS. In approving the field sequential system.

Dr. BAKER. Yes, sir.

Mr. HARRIS. Now, could you describe in a very brief description, that a layman can more or less understand—I realize that that might be a difficult question—but could you define for us in as simple terms as you can the difference between a compatible system and the noncompatible system.

Dr. BAKER. Yes, sir. That is relatively simple.

If you have a black and white receiver in your home and you are looking at the color system which is compatible, which is the system which is the standard recommended by the NTSC you will then see on your receiver a black and white picture of the color transmission. That is compatible. That is a color transmission which is received in color on a color receiver and in black and white on a black and white receiver.

Mr. HARRIS. Well now, suppose you have a black and white receiver? I was under the impression in the previous discussions here, and testimony, that a compatible system meant that a black and white receiver would receive color.

Dr. BAKER. Yes, but it would receive it in black and white, sir. It does not receive it in color. Do I make myself clear?

Mr. HARRIS. Can you receive that in color on a black and white receiver?

Dr. BAKER. You can, but it is impracticable and uneconomical to do it. It would require such major changes in a black and white receiver to receive a color program in color that you would be much better off

to buy a color receiver and thereby receive color and black and white on the one receiver.

Mr. HARRIS. In other words, the whole problem then is related to the broadcaster?

Dr. BAKER. Well, yes; he basically starts it as to whether he will broadcast black and white or color.

Mr. HARRIS. And the effect one way or the other on the type of standards actually gets to the broadcaster who has the transmitter to send these signals?

Dr. BAKER. That is right; yes, sir.

Mr. HARRIS. And the question is—do I understand it correctly—that under a compatible system the broadcaster has transmitting equipment with which he can transmit the signals which will be received on black and white as well as on color receivers.

Dr. BAKER. Yes, sir; that is right.

Mr. HARRIS. And your noncompatible system is one which the transmitter has got to either send color or black and white signals.

Dr. BAKER. Yes; and if he sends color with his transmitter, your black and white receivers will not receive a color transmission in black and white.

Mr. HINSHAW. Will the gentleman yield for a question there?

Mr. HARRIS. Yes, I will yield to the gentleman.

Mr. HINSHAW. It has been testified to before this committee that by a small modification, a black and white receiver would be able to receive color in addition to black and white, on the incompatible; field sequential system.

Mr. HARRIS. Yes, I recall that Mr. Stanton, I believe, and maybe one or two other witnesses explained that there could be a converter, perhaps, placed upon the receiving set and, therefore, it would receive the signals. Is that your understanding that that can be done?

Dr. BAKER. There is no question but that it can be done; but it is a very difficult way to do it, and it would be an expensive and uneconomical thing.

And, let me point out this one fact, if I may. If you have a television—let us say that you have a black and white receiver in your home and you want to get it converted to receive color, and you have 2 or 3 servicemen come in there and work on it for 4 or 5 hours, and they put on a lot of gagets that are hung on to the receiver. You are not going to be very contented with that receiver in your living room.

So, all of these magnificent modifications and attachments that people talk about are not practicable; are not economical. It is just like you have an automobile with just 2-wheel brakes on it, and the industry brings out 4-wheel brakes. The chances are that you will not go down and have that automobile converted into a 4-wheel brake machine.

Mr. ROGERS. Will the gentleman yield?

Mr. HARRIS. I will yield.

Mr. ROGERS. Doctor Baker, what part does the Lawrence tube pay in this?

Dr. BAKER. The Lawrence tube is a tube that was developed by Ernest Lawrence and was taken over by Chromatic Laboratories, and they have carried on the development since then. That Lawrence tube was the Chromatic Laboratory tube which I spoke about a short time ago. Dr. Lawrence was the inventor; conceived that idea.

Mr. ROGERS. Could that be used in the conversion of the black and white to color?

Dr. BAKER. The Lawrence tube has potentialities. It has potentialities of being used in the field sequential system; yes, sir. It looks as if it could be used in there, but it does not make the system practical, sir.

Mr. HARRIS. That is all. Thank you very much.

Mr. ROGERS. That is all.

Dr. BAKER. May I say, Congressman, I have had given to me a single sheet which shows the revised NTSC color field test specifications, I will send copies to the rest of you gentlemen soon, but I would like for you to have this one.

Mr. HARRIS. I think perhaps it would be preferable to have it put in as a part of the record.

The CHAIRMAN. It may be put in the record at this point.

(The material referred to is as follows:)

Television Digest with ELECTRONICS REPORTS

WYATT BUILDING WASHINGTON 5, D. C. • TELEPHONE STERLING 3-1755

Supplement No. 75-A
February 14, 1953

Transmission and Reception

Revised NTSC Color Field Test Specifications

Technical Details of Signal to Be Tested During Forthcoming Months

Approved for Publication Feb. 2, 1953 by NTSC Editorial Committee

Changes Based on Field Tests Conducted with Earlier Specifications Announced Nov. 26, 1951
And Published by *Television Digest* as Supplement No. 75 on Dec. 1, 1951

TEST SPECIFICATIONS—GROUP I

(1) The image is scanned at uniform velocities from left to right and from top to bottom with 525 lines per frame and nominally 60 fields per second, interlaced 2-to-1.

(2) The aspect ratio of the image is 4 units horizontally and 3 units vertically.

(3) The blanking level is fixed at 75 per cent (±2.5 per cent) of the peak amplitude of the carrier envelope. The maximum white (luminance) level is not more than 15 per cent nor less than 10 per cent of the peak carrier amplitude.

(4) The horizontal and vertical synchronizing pulses are those specified in Section 3.682 of Subpart E of Part 3 of the *FCC Rules Governing Radio Broadcast Services* (as amended April 11, 1952; effective June 2, 1952), modified to provide the color synchronizing signal described in Specification 21 (Group II of these specifications).

(5) An increase in initial light intensity corresponds to a decrease in the amplitude of the carrier envelope (negative modulation).

(6) The television channel occupies a total width of 6 mc. Vestigial-sideband amplitude-modulation transmission is used for the picture signal in accordance with the FCC Rules cited in Specification 4, above.

(7) The sound transmission is by frequency modulation, with maximum deviation ± 25 kilocycles, and with pre-emphasis in accordance with a 75-microsecond time constant. The frequency of the unmodulated sound carrier is 4.5 mc ± 1000 cycles above the frequency of the main picture carrier actually in use at the transmitter.

(8) The radiated signals are horizontally polarized.

(9) The power of the aural-signal transmitter is not less than 50 per cent nor more than 70 per cent of the peak power of the visual-signal transmitter.

TEST SPECIFICATIONS—GROUP II

(10) The color picture signal has the following composition:

$$E_m = E'_Y + \left\{ E'_Q \sin(\omega t + 33°) + E'_I \cos(\omega t + 33°) \right\}$$

where

$$E'_Q = 0.41\,(E'_B - E'_Y) + 0.48\,(E'_R - E'_Y)$$
$$E'_I = -0.27\,(E'_B - E'_Y) + 0.74\,(E'_R - E'_Y)$$
$$E'_Y = 0.30\,E'_R + 0.59\,E'_G + 0.11\,E'_B$$

The phase of the color burst is $\sin(\omega t + 180°)$

Notes: For color-difference frequencies below 500 kc, the signal can be represented by

$$E_m = E'_Y + \left\{ \frac{1}{1.14}\left[\frac{1}{1.78}(E'_B - E'_Y)\right] \sin \omega t + (E'_R - E'_Y) \cos \omega t \right\}$$

In these expressions the symbols have the following significance:

E_m is the total video voltage, corresponding to the scanning of a particular picture element, applied to the modulator of the picture transmitter.

E'_Y is the gamma-corrected voltage of the monochrome (black-and-white) portion of the color picture signal, corresponding to the given picture element.

E'_R, E'_G, and E'_B are the gamma-corrected voltages corresponding to the red, green, and blue signals intended for the color picture tube, during the scanning of the given picture element.

E'_Q and E'_I are the two gamma-corrected orthogonal components of the chrominance signal corresponding respectively to the narrow-band and wide-band axes.

ω is 2π times the frequency of the chrominance sub-carrier. The phase reference of this frequency is the color synchronizing signal (See Specification 21 below) which corresponds to amplitude modulation of a continuous sine wave of the form $\sin(\omega t + 180°)$ where t is the time.

The portion of each expression between brackets represents the chrominance subcarrier signal which carries the chrominance information.

It is recommended that field-test receivers incorporate a reserve of 10 db gain in the chrominance channel over the gain required by the above expressions.

(11) The primary colors referred to by E'_R, E'_G, and E'_B have the following chromaticities in the CIE system of specifications:

	x	y
Red (R)	0.67	0.33
Green (G)	0.21	0.71
Blue (B)	0.14	0.08

(12) The color signal is so proportioned that when the chrominance subcarrier vanishes, the chromaticity reproduced corresponds to Illuminant C ($x = 0.310$, $y = 0.316$).

(13) Gamma correction is such that the desired pictorial result shall be obtained on a display device having a transfer gradient (gamma exponent) of 2.75. The equipment used shall be capable of an overall transfer gradient of unity with a display device having a transfer gradient of 2.75. The voltages E'_Y, E'_R, E'_G, E'_B, E'_Q, and E'_I in the expression of Specification 10, above, refer to the gamma-corrected signals.

(14) The color subcarrier frequency is 2.579545 mc ± 0.0003% with a maximum rate of change not to exceed 1/10 cycle per second per second.

(15) The horizontal scanning frequency is 2/455 times the color subcarrier frequency. This corresponds nominally to 15,750 cycles per second (the actual value is 15,734.264 ± 0.047 cycles per second).

(16) The bandwidth assigned to the monochrome signal E'_Y is in accordance with the FCC standard for black-and-white transmissions, as noted in Specification 6 above.

(17) The bandwith assigned prior to modulation to the color-difference signals E'_Q and E'_I is given by Table I.

Table I

Q-channel bandwidth

at 400 kc less than 2 db down
at 500 kc less than 6 db down
at 600 kc at least 6 db down

I-channel bandwidth

at 1.3 mc less than 2 db down
at 3.6 mc at least 20 db down

(18) E'_Y, E'_R, E'_G, E'_B, E'_Q and E'_I are all matched to each other in time to within ±0.05 microseconds. This is a tentative tolerance to be established definitely later.

(19) The overall transmission bandwidth assigned to the modulated chrominance subcarrier shall extend to at least 1.5 mc below the chrominance subcarrier frequency and to at least 0.5 mc above the chrominance subcarrier frequency, at an attenuation of 2 db.

(20) A sinewave, introduced at those terminals of the transmitter which are normally fed the color picture signal, shall produce a radiated signal having an envelope time delay, relative to 0.1 mc, of zero microseconds up to a frequency of 2.5 mc; and then linearly decreasing to 4.3 mc so as to be equal to −0.26 microseconds at 3.579545 mc. The tolerance on all these delays shall be ±0.05 microseconds relative to the delay at 0.1 mc.

(21) The color synchronizing signal is that specified in Figure 1.

(22) The field strength measured at any frequency beyond the limits of the assigned channel shall be at least 60 db below the peak carrier level.

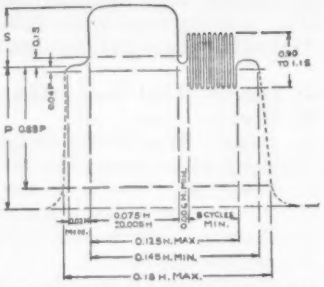

Fig. 1.—Revised Specifications for Field Test of NTSC Compatible Color Television

Notes:

(1) The radiated signal envelope shall correspond to the modulating signal of the above figure, as modified by the transmission characteristics of specification number 6.

(2) The burst frequency shall be the frequency specified for the chrominance subcarrier. The tolerance on the frequency shall be ±0.0003% with a maximum rate of change of frequency not to exceed 1/10 cycle per second per second.

(3) The horizontal scanning frequency shall be $\frac{2}{455}$ times the burst frequency.

(4) Burst follows each horizontal pulse, but is omitted following the equalizing pulses and during the broad vertical pulses.

(5) Vertical blanking 0.07 to 0.08V.

(6) The dimensions specified for the burst determine the times of starting and stopping the burst, but not its phase.

(7) Dimension "P" represents the peak-to-peak excursion of the luminance signal, but does not include the chrominance signal.

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Zenith Radio Corp.—Joe Spindler.

Mr. YOUNGER. Will the gentleman yield?

Mr. HARRIS. I had already yielded the floor. I will be glad to yield, if I may.

Mr. YOUNGER. Did you furnish the FFC with the set of standards when you furnished the industry with them?

Dr. BAKER. Oh; yes. All of our material goes to the FFC.

Mr. YOUNGER. I just wanted to put that in the record at this point. That is all. Thank you.

Mr. HINSHAW. Dr. Baker, I seem to note that the formation of the NTSC was immediately subsequent to the establishment of the standards in respect to the field sequential system. Was that evidence of the desire on the part of the manufacturers not to proceed under the field sequential system? Is that true?

Dr. BAKER. I do not think you would quite say that.

When I testified at the hearing I pointed out to the Commission the great similarity between this controversy on color; the great similarity between what took place and what took place in the monochrome, and I asked the Commission if they would not recognize the establishment of a second NTSC to thoroughly explore the technology of color and that was not granted.

As a matter of fact, the second NTSC was formed prior to the closing of the color hearings.

Mr. HINSHAW. I perceive that all right; but when the standards were established, the normal procedure of the industry would be a desire to cooperate with those standards and proceed to manufacture and distribute according to those standards; would it not?

Dr. BAKER. That is right; and I think you will find that a number of companies began to study color television receivers, using the field sequential, and a number of companies built prototypes. There was little, if any, transmission, you know. Their transmission was not even approached on any national scale.

And then, of course, the Korean situation had almost the same effect on that particular commercialization as World War II had on monochrome.

Mr. HINSHAW. To say nothing of legal actions in the courts?

Dr. BAKER. Well, the NTSC—yes, there was some action in the courts. That is true. But actually, the impact of the Korean war on industry was very, very considerable.

Mr. HINSHAW. Well, now let us get down to cases and talk about that, because they proceeded to manufacture, in the industry, black and white receivers.

Dr. BAKER. That is right.

Mr. HINSHAW. And those receivers required practically the same material that would have been required in color receivers. So, it did not have much to do with the Korean war, so far as the material is concerned.

Dr. BAKER. If you want to limit that statement to materials, I can accept it with some qualifications. We were all cut back in our black and white products.

Mr. HINSHAW. But still you produced 7 million receivers a year during the Korean situation, which is several times the number produced before.

Dr. BAKER. We produced a lot of receivers.

Mr. HINSHAW. Several times what you produced before, when the Korean war was not on.

Dr. BAKER. That is right; but let me point this out, if I may: There was an impact on the industry, due to the Korean situation, and materials whether it was large or small. There was that impact. I know in my own company we were very definitely restricted. But, there was a secondary impact of really much greater importance and that was the impact on the technology of the industry.

World War II had a trenmedous impact on technology of our industry, because World War II is when we really found out how to fight a war using electronics.

So, when the Korean situation came along the demand for electronics, electronic equipment was even greater than it was in World War II. I can give you an example from my own operations. In the 4 last years of World War II, which of course was the 4 most important

years, in my particular operations, I expended 5½ millions of engineering man-hours—that was in 4 years of World War II. Yet, from the beginning of the Korean situation I expended 6.3 million engineering man-hours in the development, design, of electronic equipment.

The only point I want to make is that even if there had been almost unlimited material, the war effort would have been seriously hampered if the industry had not thrown its manpower into the Korean War situation.

Mr. HINSHAW. We can argue as to whether the efforts of the engineering talent, and so forth, were applied to the Korean situation. That is an incident. We can say that the money was made available during the Korean incident for you to apply the technology, but in all probability it was for use in some subsequent event to the Korean event, because it has always been so.

Now, you mean by material shortages, shortages affecting the situation in that you were not permitted to make 12 million receivers instead of 7 million receivers?

Dr. BAKER. Well, I am not in a position to say whether the industry would have made 12 million receivers or not.

Mr. HINSHAW. After all, the number of receivers manufactured was away in excess of the number that was manufactured just prior to Korea. So you must have been given a lot of material.

Dr. BAKER. Yes; they built many receivers and used the material.

But, you must also remember, sir, that the industry in that period, as they did in World War II, an outstanding job in shifting materials and substituting one material for another. We were greatly restricted in copper. We were greatly restricted in aluminum and the engineers were forced to develop circuits and to do things like that rather than build new types of receivers, which is the normal trend in industry. We were forced to do everything possible to save material. I cannot give you the figures. They are undoubtedly available. I suppose, with a given pound of copper this industry was forced to do two or three times what it would normally do with that kind of copper.

Mr. HINSHAW. Yes, but do not leave the impression with this committee that there was a great shortage of material that was due to Korea, which restricted the production of receivers, because it did not restrict the production of receivers.

Mr. HARRIS. Will the gentleman yield?

Mr. HINSHAW. Yes; I will yield.

Mr. HARRIS. As I understand, the NPA had an order which prevented the production of color television.

Dr. BAKER. Yes, sir.

Mr. HINSHAW. That is correct, the order M–90 prevented the production of color television, but that is the first and only time that an order had been issued preventing the end-point use of material. It did not prevent the production of black and white receivers, which use the same material. That is the point that I would like to make.

Dr. BAKER. But it was not possible at that time, if I remember rightly—I attended both of those meetings. It seems to me that anyone in the industry could have used black and white material for the production of color if they so elected.

Mr. HINSHAW. Yes.

Dr. BAKER. That is right.

Mr. HINSHAW. Exactly. So that that does not have much to do with it. Of course the issuance of order M–90 had a good deal to do with it.

Dr. BAKER. That is right.

Mr. HINSHAW. And, the question which we would like to know the answer to is "How come the order M–90 was issued?"

Dr. BAKER. Well, that I cannot say. I do not know.

Mr. HINSHAW. The real point in this matter is, that is the only "end use" order that was issued during the Korean incident.

Dr. BAKER. That, sir, I do not know.

The CHAIRMAN. If you will yield, I have no hesitancy in saying that if the order had not been repealed, we would have had the NPA here to answer that.

Mr. HINSHAW. Yes, and I think that they probably should be.

The CHAIRMAN. It is not necessary now, in my opinion, since it has been rescinded.

Mr. HINSHAW. Well, maybe so. I do not want to argue that point with the chairman.

I would like to know then if the establishment of the NTSC for the purpose of devising a different set of standards was not, as you might say, indirectly against the order of the Commission, because you had a set of standards established already by the Commission and you had the go-ahead on the matter of production of color television, and yet no manufacturer proceeded?

Now, let us get it all straight so we can start from scratch and be of some assistance.

The manufacturers, let us say, did not want to proceed with that system, so they did not. Is that right?

Dr. BAKER. I would not put it quite as baldly as that; no. I would say this, that the manufacturers, and their engineers, and primarily their engineers, felt that the field sequential system was technically inadequate for reasons which I have already stated and for reasons which have been submitted as testimony.

Mr. HINSHAW. Well, let us say that it was all bad. I am assuming that it was abandoned because they would not back it up, for more than two reasons. One would be a patent situation and another would be the fact that the standards were not adequate for the purpose.

Dr. BAKER. A number of companies did start building prototypes of the CBS receiver. My own company did.

The pressure of the military work and the need for engineers on that, plus the fact that there was no extensive broadcasting, and hence no extensive demand from the consumers—the industry did not develop rapidly and then M–90 came along and stopped it cold.

Mr. HINSHAW. Now, that does not account for the reason why you were able to accumulate some of the finest engineering talent in the business in the NTSC and there spend some time on it.

Dr. BAKER. Well, let me say this: When you are talking about the NTSC, you are talking about 200 engineers out of a total of—well, I do not know how many engineers—but I know that the Institute of Radio Engineers has enrolled about 32,000. Now, they are not all the kind of engineers that I am referring to.

Mr. HINSHAW. And they are not all engaged in television work.

Dr. BAKER. No, they are not; but in my own particular case, at that time and now we are doing considerable—we are doing considerable work on television for the military and that is even going on today, on projects for the various military services, involving television work.

So that I really feel that about all that could be done was done prior to the issuance of M–90.

Mr. HINSHAW. Well, let us say that everything was done that could be done and that the order M–90 was justified, and all of the rest of it.

Now, let me ask you one further question. Would you now have rescinded, that is, have the FCC rescind the standards that have already been published?

Dr. BAKER. Yes, sir.

Mr. HINSHAW. And that was the objective of the NTSC in the first place, was it not?

Dr. BAKER. I do not think so. The object of the NTSC was not set up to specifically and definitely rescind the field sequential standards. The object of the NTSC was to produce a compatible system of color television and salvage the 7 million black and white receivers that were already on the market and any that could come along.

Mr. HINSHAW. You do not want to apparently admit that the industry did not want to produce the incompatible system; but you say that the object, as you state, was to set up a compatible system, and, of course, that was in opposition to the standards that were established by the Commission and consequently one of the objectives must have been to get those standards rescinded.

Dr. BAKER. As an end result, probably so; but all——

Mr. HINSHAW. Then, why didn't you come out in the first place and say so?

Dr. BAKER. Because that was not the primary reason for establishing the NTSC.

Mr. HINSHAW. But you had a standard already accepted. Now, you could have proceeded on those.

Dr. BAKER. Yes.

Mr. HINSHAW. Now, was it not possible for the NTSC to point out how the industry might be able to string along on the lines already established?

Dr. BAKER. That was not the function of the NTSC. The NTSC and the whole industry would have had little to say about it if at the time the field sequential system was installed, there was in fact put in place across this country 20 or 30 or 40 or 50 field sequential transmitters. That is what would determine it.

Mr. HINSHAW. But, you said that the NTSC was created before the standards were established.

Dr. BAKER. It was.

Mr. HINSHAW. Before they were published.

Dr. BAKER. Yes, sir.

Mr. HINSHAW. And you said that the purpose of the NTSC was to set up a compatible system.

Dr. BAKER. Yes, sir; but that does not stop anyone from going ahead and putting in place a field sequential system. That is, CBS could have installed it on its own networks all around the country, on CBS's transmitters and——

Mr. HINSHAW. If the manufacturers would not have made sets, receivers, what would have been the good of setting up transmitters?

Dr. BAKER. I would not say so. I do not believe that can be shown, sir. I know that a number of manufacturers had in fact prototype CBS receivers built and had told their distributors that they would in fact produce and sell them when there was broadcasting.

Mr. HINSHAW. Well, there could not be any broadcasting without any receivers.

Dr. BAKER. And there would not be any receivers, without broadcasting.

Mr. HINSHAW. And, of course, that action pretty nearly justifies Senator Johnson's charge that the industry went on a sitdown strike.

Dr. BAKER. No, sir; that is not so. The industry did not go on or enter into a sitdown strike at all.

Mr. HINSHAW. Well, it looks to me very much so and—I do not deny that what you say is all provable; but, go ahead.

The CHAIRMAN. I would like to have a word or so, if you have no objection.

Mr. HINSHAW. No.

The CHAIRMAN. Did the order that was made by the FCC that recognized the Columbia, so-called Columbia system, have an open door or leave an open door for further consideration by the industry with respect to a different type?

Dr. BAKER. Yes, sir.

The CHAIRMAN. Well, is not that the answer then?

Dr. BAKER. It is.

The CHAIRMAN. That the FCC itself in fixing the acceptance of the Columbia system recognized that it might not be acceptable and by its order made it possible, if it did not encourage, the doing of the very thing that your committee did.

Dr. BAKER. That is right, sir. That is in the document that I read from whereby the FCC stated——

The CHAIRMAN. And would it not seem that the subsequent developments that have occasioned even the representatives of Columbia in appearing before this committee and acknowledging the deficiency of their system, and the greater perfection of this more recent system, thereby justify the action that had been taken by the FCC and by the industry, through this committee?

Dr. BAKER. Yes, sir.

The CHAIRMAN. In the course that it has pursued.

Dr. BAKER. That is right, sir.

The CHAIRMAN. To the end that we now have a system that even the Columbia recognizes as superior to the one that the FCC had adopted.

Dr. BAKER. That is right.

The CHAIRMAN. Mr. Rogers.

Mr. ROGERS. Dr. Baker, I am just a little interested in your recommendation. That is, the NTSC's recommendation, and I particularly want to refer to No. 2. You say:

> 2. That the Federal Communications Commission formally recognized the existence of NTSC, and lend its active support to the NTSC program.

Dr. BAKER. Yes, sir.

Mr. ROGERS. Now, what is your thought as to how that can be done by this committee?

Dr. BAKER. Well, sir, I do not know that I can say more than that.

In the first place, when NTSC was first established, Mr. Fly, who was chairman of the Commission, put this committee in place, to make the scientific studies in monochrome, and I recommended that procedure at the color hearings, and it was not acted upon.

We would like to be recognized by the Commission as the committee that is studying this system for them.

Mr. ROGERS. Well now, you ask that our committee do something. You recommend or ask this committee, by some positive action, to agree with this recommendation.

Now, if this committee did do that, do you not think it would be encroaching to some extent upon the powers and duties of the Commission that is duly set up by law?

Dr. BAKER. Well, I cannot say, sir, except, you might suggest it. That does not force them to do anything. You can simply suggest it.

Mr. ROGERS. Now, if the Commisison, the FCC, were to be requested by this committee, or by some resolution passed by the Congress, to give active support to the NTSC, and you are opposing the field sequential system, just where are we?

Dr. BAKER. Well, I think that the Chairman answered that a few minutes ago, when he stated that the FCC in its specifications announced how a new petition should be put in, and really in the establishment and approval of the field sequential system, it indicated the desirability of a simultaneous system.

Mr. ROGERS. Now, you do not approve of the field sequential system.

Dr. BAKER. The field sequential.

Mr. ROGERS. Yes.

Dr. BAKER. No, sir.

Mr. ROGERS. Well now if this committe were to ask the Commission, or if it were to give full approval to your program, then, if the Commission did that that would be out at the window.

Dr. BAKER. Yes, sir; it would. I think that this committee could suggest to the FCC that it ask the NTSC to present its technical story to the FCC in exactly the same way that it was done in the monochrome.

Mr. ROGERS. But, you would not ask us to go so far as to give active support to your program and disregard any other system that might be presented to us.

Dr. BAKER. No; I do not think the NTSC needs that type of support. I think it would be very helpful if you suggest that they listen to the NTSC's story. You understand that they have not refused to listen to it; but we have to go through the laborous petition operation.

The CHAIRMAN. Will the gentleman yield?

Mr. ROGERS. Yes, I will yield to my friend, our able chairman.

The CHAIRMAN. I had not observed that in the recommendations that have been presented to the committee this morning that there was any suggestion that the FCC should adopt the NTSC's standards. I do not take it that there was anything other than a suggestion or a hope that the FCC would facilitate consideration.

Dr. BAKER. That is right.

The CHAIRMAN. The testing, which is now immediately ahead of you.

Dr. BAKER. That is right.

The CHAIRMAN. This is before you do make any definite standards.

Dr. BAKER. That is right.

The CHAIRMAN. When you have done so and they are presented to the FCC, then the FCC is to determine whether they will accept it, or whether they will hold hearings, or adopt their own procedure as to the manner in which they will give consideration to what your committee fully submits to it.

So, I do not take it that there is any intention upon the part of your committee, or any suggestion made to it, that it should do anything that would in any sense whatsoever violate the full free right of the FCC to determine the course of action it should take.

Dr. BAKER. That is correct, sir.

The CHAIRMAN. I do think that it is particularly appropriate that we should bring to the attention of the FCC the recommendations of this very outstanding committee to the end that we may then have some action for or against, or otherwise, by the FCC to advance and assist in the bringing acceptable color television into being for the use of the public at the earliest possible date.

Mr. ROGERS. Mr. Chairman, you have a little different interpretation of the words than I have.

The CHAIRMAN. Well, if you will point out the words maybe I will have to revise my statement.

Mr. ROGERS. I would not say that. We can interpret things differently, Mr. Chairman.

The CHAIRMAN. What are you referring to?

Mr. ROGERS. Where they ask that we actually support the program. That means, that if I support something I am going to get behind it and do something for it, and that is the word that is used here.

The CHAIRMAN. Where is that?

Mr. ROGERS. No. 2 on page 20. The recommendation is "that the Federal Communications Commission formally recognize the existence of the NTSC, and lend its active support to the NTSC program."

The CHAIRMAN. Which is one of testing.

Mr. ROGERS. That is your interpretation? I just wanted to see what his interpretation was. If he interprets it loosely, and not that they adopt the plan, I will agree with the chairman. I am glad to have your interpretation, Doctor.

Dr. BAKER. The NTSC expects to prove its case, sir. We are not asking anything that would eliminate that.

Mr. ROGERS. In other words, if some other system is presented that is more meritorious, you would want to adopt the other system?

Dr. BAKER. That is right. If we cannot prove our case, then our case is not good enough for the American public.

Mr. ROGERS. Thank you.

Mr. HESELTON. Mr. Chairman.

The CHAIRMAN. Mr. Heselton.

Mr. HESELTON. Doctor, aside from the granting by the Commission of the privilege of testing between 7 a. m. and noon, is there anything else in the terms of the field testing that the FCC could do to be of assistance?

Dr. BAKER. No, sir; I do not think so. I believe the rest we can handle ourselves.

Mr. HESELTON. And in terms of your recommendations that nothing be done to interfere with the completion of the current field testing program; aside from the fear that you expressed as to hasty action on

the part of the FCC in announcing that color television was commercially feasible, is there anything else that concerns you?

Dr. BAKER. No, sir; I think that is the only thing.

Mr. HESELTON. You said in recent tests that receivers were used, as I got it, from 18 manufacturers.

Dr. BAKER. Yes, sir.

Mr. HESELTON. That many were used.

Dr. BAKER. Yes, sir.

Mr. HESELTON. Those I take it were prototypes?

Dr. BAKER. They are prototypes.

Mr. HESELTON. What kind of tubes were they using?

Dr. BAKER. Practically all used the RCA tube or a replica of the RCA tube. That is, many manufacturers working with the manufacturing process to build that type of tube.

Generally they all use the tricolor tube of the hole-plate type, which is the RCA idea.

Mr. HESELTON. Are the standards adopted by the Federal Communications Commission for black-and-white television tied to the patents of any particular company in the sense that the manufacturer of broadcasting equipment or receiving sets have to pay royalties to that particular company?

Dr. BAKER. Well, practically the entire industry is licensed by RCA.

Mr. HESELTON. By RCA?

Dr. BAKER. Yes.

Mr. HESELTON. And have to pay them royalty?

Dr. BAKER. Yes; we pay royalty to the RCA.

Mr. HESELTON. What is the patent situation in this regard with respect to the field sequential system adopted by the FCC for color television?

Dr. BAKER. I do not know, sir. I can give you no information with respect to the patent situation on any type of color.

Mr. HESELTON. Then apparently you cannot answer the last question I had on that. I would like to have it in the record.

What would be the patent situation in that regard if the FCC should adopt the standards proposed by the National Television System Committee?

Dr. BAKER. I cannot say.

Mr. HESELTON. When Dr. Engstrom was here I read to him a quotation from the Radio Daily attributed to you in which you are purported to have said, "I have no opinion as to when color television will be launched full scale. Until extensive field and operating tests have been conducted to locate all possible faults any guess on commercial color TV as a home service would be premature and without foundation."

He commented on that to say:

> We do have ahead of us some field tests. We are more optimistic possibly than some of the others because we have had more experience. We have had more assurance. We have had more knowledge, but the NTSC is a technical body and is making these field tests, and when they are finished we expect to have the data which will substantiate the situation and we will be in a position for submission to the Federal Communications Commission.
>
> Now, if Dr. Baker has made that statement with respect to the NTSC then, I desire to have a discussion with him at the next meeting, because I am more optimistic than he indicates, and I do not share those views.

I take it that you referred to that previously, that being your February statement.

Dr. BAKER. That is right.

Mr. HESELTON. Well, would you care to comment any more fully on that?

Dr. BAKER. I believe that the whole crux of the matter is determined on how you want to define "commercialization." I am sure that once the system is commercialized, the industry will go as rapidly as they can. I do not know the date that the field tests will be completed. Frankly I am just as optimistic as to the result of the field tests as is Dr. Engstrom. But until they are completed and the NTSC is in a position to say that these are right, I do not care to anticipate that situation and say that the NTSC thinks that everything is going all right.

Personally, I think that the standards are correct; that the field tests will prove it.

After that is done, then you have to go through the hearing situation and then you have to tool up, as was mentioned by Mr. Stanton, of the CBS. I am sure that the industry will go as fast as they possibly can.

Mr. HESELTON. There has been considerable reference to this field test. I wonder if you can concisely describe the type of testing that is done.

Dr. BAKER. Well, I had some—without going into very much detail, let me say this, that in addition to certain laboratory tests which are in continuous operation, we have to operate transmitters and receivers in the normal way that they would be operated in the system, so that we have transmitters in New York; two, one by Du Mont and one by RCA. We have a transmitter in Philadelphia—the Philco Co. We have a transmitter in Syracuse, General Electric, and there will be a transmitter in Chicago—Zenith.

Now, the first thing that has to be done with those transmitters is for the field testing committee to certify that they are in fact sending out the signal which is in conformance with the standard of the NTSC and that has been done on the transmitters in New York and Philadelphia, and the one in Syracuse. It has not as yet been done on the one in Chicago.

And then we encourage the various manufacturers to build prototypes to test at various locations.

Mr. HESELTON. May I interrupt you there. Are there more than 18 prototypes in existence?

Dr. BAKER. Yes; some of the companies have built more than one prototype. We would like to get as many companies as possible to build prototypes, because then we can obtain different designs. The engineers of no two companies will produce the same design. We want that so we will find out whether in the limits of the engineers, we will be in trouble. That is, one engineer's design will be a circuit that way (indicating) and another one this way. And we want to find out if we put them on the signal if they will work.

So that we have those receivers which have to be tested at different ranges, different distances from the transmitter.

Mr. HESELTON. And I assume at different times of day.

Dr. BAKER. And at different times of day. And then we will test them for the characteristics, which I referred to, which was flicker,

brightness, color breakup, fringing; their sensitiveness and susceptibility to interference from man-made interference or other transmission; and how good they are in the fringe area.

Mr. HESELTON. I take it that as far as you can you have set up some kind of a time schedule for the completion of these sets.

Dr. BAKER. We have set up a time schedule, as good as we can. It is not too good, because much of the work depends upon when we can have the tests.

Now, in Syracuse where the transmitters are supposed to go on April 1, we have 3 solid days of testing, April 14, 15, and 16. There we can test night and day, because we are not troubled with this restriction, from 1 at night to 7 o'clock as we are in other areas such as New York where we have to test only from 1 at night to 7 in the morning. So that we have a pretty tight timetable. There are always slippages in these things. There are troubles that have to be met in connection with it. The more receivers you have to test, of course, the more complicated the test. There is the interference of one receiver to another; getting all of the antennas in place, and everything else. It is quite a job.

Mr. HESELTON. Is the restriction from 1 to 7 a. m. in New York due to the fact that there are commercial broadcasts that take place at other hours?

Dr. BAKER. Yes, sir. You cannot be critical of it at all. They are commercially broadcasting on the other hours and it would hardly be fair to let the NTSC go in and interfere with that commercial broadcasting. Our position is that now we feel certain that we have a compatible system and therefore the man looking at a commercial broadcast would not know whether he was looking at color or black and white.

Mr. HESELTON. That is all, Mr. Chairman.

The CHAIRMAN. Is there anything further? Any questions, gentlemen?

Mr. HINSHAW. Mr. Chairman, I just want to say that so far as my questions are concerned, they were directed at the time in which this Commission was issuing its order and not at the present. It may be that the advance in the art has been worth the trouble, but in the meantime, for several years now, the color television has been waited for by the public and has not been received. The question is why has it not been received, and I am merely trying to get an answer to that that will be satisfactory to the public.

Mr. HALE. Mr. Chairman, there is one question that I want to ask, and that is right along the line with the question that Mr. Hinshaw was asking. How much effect did this famous order M–90 actually have in retarding progress in the industry?

Dr. BAKER. Well, sir, it stopped the work on color television.

Mr. HALE. Did it? Did it stop the work, or was the work stopped for other reasons?

Dr. BAKER. No; it stopped this work, and slowed up all of the other work on it. That, and the Korean situation. In spite of what has been said, it did restrict the television work.

Mr. HALE. For the whole period during which it was in effect?

Dr. BAKER. Yes; but as the war progressed, toward the latter part of this period in particular, when the Korean war was, or seemed to be

under control, it was not of as great importance as it was in the early stages of it.

Mr. HALE. You say that it was important when it first came out, and then it became less important?

Dr. BAKER. It stopped the work when it first came out and there can always be disagreement on it, but the industry was very heavily loaded with military equipment which was under great pressure for delivery.

Mr. HALE. When did the order cease to be of importance?

Mr. BAKER. Well, as the Korean war became a question a a static war, it seemed to me then that there was less pressure by the military once that war became static; but I cannot say that with any degree of certainty. I do not know. But M–90 certainly restricted the color development and the design of all types, not only the field sequential, but of the work; interfered with the work of the NTSC. It certainly interfered with the development and design of compatible color. If it had not been for that, probably we would have been talking about this system a long time ago.

The CHAIRMAN. Are there any further questions, gentlemen?

Mr. THORNBERRY. Mr. Chairman, I would like to ask a question.

The CHAIRMAN. Mr. Thornberry.

Mr. THORNBERRY. I am very much interested particularly in the question which Mr. Hinshaw discussed. I have had the feeling all along that there has been somewhere along a desire not to have color television under the system established or approved by the Commission.

Now, getting back to M–90, Dr. Baker, did you and your committee or did you representing your company, did you receive notice from the NPA concerning order M–90?

Dr. BAKER. Well, I received a notice to appear down here at the meeting.

Mr. THORNBERRY. Yes.

Dr. BAKER. Which was held. I did attend.

Mr. THORNBERRY. Did you attend the meeting?

Dr. BAKER. Yes, sir.

Mr. THORNBERRY. What was your position on M–90?

Dr. BAKER. My position was, first, that we would do what we were told to do; that 61 percent of my engineering manpower was already tied up on military work; in addition to the 61 percent—I am trying to remember these figures—I think I said I had 4 or 5 percent of my engineering manpower tied up on television work for the military and I told the chairman of the meeting that we would do whatever the Government wanted us to.

Mr. THORNBERRY. Did you indicate that M–90 was desirable?

Dr. BAKER. I thought it was desirable, personally, for these reasons. If the industry had been given full power to produce color I would have had to divert engineers from the military work. There is no question about it; when I had 61 percent of my engineers tied up with military work and another 4 or 5 percent on closely related work, I did not have any engineering manpower left. Therefore, if colod had in fact become commercially possible, I would have had no way of protecting my future position unless I told the services, "I am unable to take on these military operations, because of the commercial situation."

Mr. THORNBERRY. Well then, what I want to get clear at this time is

this, most of the people engaged in manufacturing businesses urged and wanted M–90 issued?

Dr. BAKER. I do not think they wanted it or opposed it. I think you can say that the industry really wanted to do its work; military electronic work. If we were forced to take on color development and design, there is no question, sir, but that the military electronics work would have suffered.

Mr. THORNBERRY. Well, I understand what you are testifying. I am not arguing the case. I do not know. What I am asking is did the people engaged in manufacturing business favor, were they highly favorable to M–90?

Dr. BAKER. Yes; after it was explained. I do not think there was any opposition.

Mr. THORNBERRY. That is all.

Mr. HINSHAW. Will the gentleman yield?

Mr. THORNBERRY. Yes, sir.

Mr. HINSHAW. You do not mean that the military effort would have been slighted for the benefit of the civilians, do you?

Dr. BAKER. No, sir; not General Electric.

Mr. HINSHAW. That is the inference that one would receive from your statement.

Dr. BAKER. Let me explain it this way. I would have been confronted with an extremely difficult situation. It would have been easy in one way, because the military would have to come first. In other words, there might have been other people who were not as heavily loaded as I was or who maybe did not feel the responsibility and I would have been in this position that I would have had to go out and hire engineers from other people under some conditions in order to try to say in business.

Mr. HINSHAW. But you could not let the military down?

Dr. BAKER. Oh, no; no, sir. Not at all. That would be impossible.

Mr. HINSHAW. That is all.

The CHAIRMAN. That will be all then, Doctor.

We again express our approciation for your having appeared this morning and for the help that you have given the committee in its study of this important matter. I have already indicated that is it the intention of the committee to have he representatives of the FCC before us on Tuesday next.

What the future course will be beyond that, after we have had the the demonstrations, will be determined thereafter.

Mr. BAKER. Mr. Chairman, I have been told that I inadvertently failed to mention CBS, Columbia, and Chromatic Television Laboratories as a part of the list of the NTSC. May I have your permission to insert them?

The CHAIRMAN. Certainly.

And, I would like to insert at this place in the record a communication which I have received from the Philco Corp. at Philadelphia relating to its position on color television. It will be made a part of the record at this point.

(The statements are as follows:)

MARCH 23, 1953.

PHILCO'S POSITION ON COLOR TELEVISION

As one of the largest manufacturers of television and radio receivers, Philco Corp. is keenly aware of the importance of adding color to the existing television service as soon as a color system has been developed to the point of an acceptable public service, and the public can be offered color receivers that are not threatened with early technical obsolescence.

At this point, Philco believes that color television has not reached this stage of development and has not been adequately field tested. We do feel, however, that the color system on which Philco is working in cooperation with the National Television System Committee gives promise of ultimate success.

Our conclusions, which follow, are backed by 25 years of experience and research in the field of television:

1. Color television can only be successful if built upon the basis of a sound black and white television service; color must and can be added to that service in such a way as to maintain the service being enjoyed from the 21,500,000 television receivers now in the hands of the public.

2. Since the earliest days of television, Philco has constantly asserted the position that no broadcast service should be authorized until it has been demonstrated that it can provide adequate public service and protect the public's investment in receivers.

3. The desire in 1950 for immediate action regarding color television forced the Commission into a decision which was inconsistent with their position through all the years preceding the establishment of black and white television standards.

4. The status of color television today. Philco has spent millions of dollars in research and development work on color television with the objective of bringing to the American pepople an adequate system of compatible color broadcasts. Philco has contributed to the work of the National Television System Committee which, we believe, now has approached a color system that will meet the tests of quality and endurance. We, like other manufacturers, are not field testing this system, and if these tests meet our expectations, we expect to petition the Federal Communications Commission for the adoption of standards based on this system.

Attached hereto is an outline of Philco's views in greater detail.

PHILCO CORP., *Philadelphia, Pa.*

THE FACTS ABOUT COLOR TELEVISION

1. Color television can only be successful if built upon the basis of a sound black and white television service; color must and can be added to that service in such a way as to maintain the service being enjoyed from the 21,500,000 television receivers now in the hands of the public.

There are now 21,500,000 television receivers in the homes of the American people. These receivers represent a tremendous investment by the public. But, without broadcasting and good programs these receivers are valueless. No system of color television which would in any way interfere with the continuing usefulness of these receivers or with the quality of programs available to their owners, can be considered either realistic or in the public interest.

The television broadcaster can provide the excellent programs now available to the public because of the great size of his black and white audience. No broadcaster could afford nor would it be right for him to forsake his large audience to provide color service to a select few fortunate enough to own a color receiver, and no system of color television which would require this is economically sound.

The television industry is an increasingly large and vital segment of our American economy. Hundreds of thousands of dealers, distributors, servicemen, and employees of manufacturers and broadcasters earn their livelihood from it. An important part of our defense effort depends upon the resourcefulness

of its engineers and scientists and the skillfulness of its manufacturers. No scheme of color television which would tend to disrupt this industry can be considered to be in the public interest, nor would it serve the long-term interests of color television itself.

If the approved noncompatible system of color television in 1950 had actually gone into commercial use the only color programs which might have been broadcast would have been at the expense of black and white programs and the present television audience. These programs could not have been received by the millions of receivers then in the homes of the American public. With the resultant confusion and loss of black and white program service, the electronics industry would have been badly disrupted.

A compatible system of color television—one in which color is added to the existing standards in such a way as not to interfere with the present black and white service—will avoid all these serious disadvantages. A fully compatible color television system is the only economically feasible way of having color television.

2. Since the earliest days of television, Philco has consistently asserted the position that no broadcast service should be authorized until it has been demonstrated that it can provide adequate public service and protect the public's investment in receivers.

Before any broadcast service can be established on a commercial basis, the Federal Government, acting through the Federal Communications Commission, must approve broadcast standards. The setting of standards has invariably produced a struggle between those who desire an immediate fixing of such standards in order to permit the public sale of receivers, as well as commercial broadcasts, and those who wish the system perfected and proven before it is adopted by the Government. The public's interest in this struggle is manifest. If commercialization is too long delayed, the public is deprived of a new service, and, on the other hand, if commercialization is permitted too soon the public will be faced with early obsolescence of the receivers in which they have invested or, alternatively, may be saddled with an inadequate system. This fundamental problem is involved whether the standards be for color transmission or black and white transmission.

It is Philco's position that any premature commercialization of a broadcast service with resulting sale of sets to the public will result in the public being loaded up with equipment that will be quickly obsolete, or with an inadequate system. The result is bound to be great public dissatisfaction with the manufacturers of the equipment, with the new broadcast service, and with the Government officials who approve the system.

The Federal Radio Commission, predecessor to the Federal Communications Commission, first made allocations for television broadcasting on an experimental basis in 1929, but the standards for this service were not set by the Commission until 1941, and, in fact, the service did not get under way on a commercial basis until 1947. During all this period, the Commission, working first through its own television committee, and later with the National Television System Committee, set up by the industry, was in constant touch with the industry.

In 1939, the Commission, resisting efforts by some members of the industry to commercialize the service immediately, set up two fundamental principles which had to be met before television broadcasting would be permitted on a commercial basis. First, fundamental research or testing of the service must be completed, and second, no public participation in the service until there were assurances of its reliability. At that time, the Commission made it clear that it intended to protect the public as much as possible against quick obsolescence of television receivers or an inadequate system.

These principles were followed by the Commission for more than 20 years and represented sound public policy.

The desire in 1950 for immediate action regarding color television forced the Commission into a decision which was inconsistent with their position through all the years preceding the establishment of black and white television standards.

The Commission, in its decision of 1950, was forced into a position not only contrary to the recommendations of the majority of the industry, but which was inconsistent with the principles which it had itself laid down in connection with the establishment of the black and white service.

The standards adopted in 1950 for color television approved a system which was incapable of being received on existing receivers. Since the color broadcasts were to be made on the same channels which were the foundation of the black-and-white service, any broadcast of color automatically eliminated a serv-

ice which could be received on black-and-white sets purchased in good faith for use on standards approved by the Government. To the extent that color was broadcast, the black-and-white service was curtailed. Conversely, to the extent that the black-and-white service was maintained, there was no color television. This meant that, instead of adding color to the existing service, the Commission provided for 2 television systems and only 1 could survive. In view of the substantial public investment in the existing black-and-white service, the result was obvious. Color cannot and should not be expected to displace the existing service and ought not to be required to do so in order to survive.

4. Present status of color television: There is little point in again debating the merits or demerits of the decision of 1950 with respect to color television. The Korean emergency required the Defense Production Authority to prohibit the production of color television receivers, and through force of circumstances the decision of 1950 is now completely out of date. Whatever might have led to the conclusion that it would be possible to establish color television without taking account of the 6 million sets in the hands of the public in 1950 can have no application to today's situation, when there are over 21,500,000 sets in American homes. Philco, individually and in cooperation with the National Television System Committee, has continued its work on a color television system that can be fitted into the existing black-and-white service to give the public a free choice as to whether it wants color or black and white. This is essential because color receivers will always be substantially higher in cost than black-and-white receivers, and it would not be in the public interest to curtail black-and-white service so that the few who could afford it might have color service.

For many years Philco has devoted a major portion of its research and development work to all phases of television; in fact, has expended several million dollars on color-television research alone. Recognizing the paramount importance of compatibility, we have sought to find the solution to the technical problems involved in adding color to the existing system. Insofar as transmission standards for adoption by the Federal Communications Commission are concerned, we have encouraged the work of the National Television System Committee to the end that the final standards of color transmission adopted by the Commission might represent the best thinking of the electronic scientists of the entire country, and not just the work of any one individual company with its own particular interests.

As of the present time, the technical feasibility of a compatible color system has been established. A tentative set of transmission standards has been adopted by the National Television System Committee. Philco, in cooperation with the other companies, is now field testing these tentative standards to satisfy ourselves that they are satisfactory and meet all the requirements for a sound public service. When this has been done and we are satisfied that the standards are such that the public can rely on the color service which they will make possible, we expect to petition the Federal Communications Commission for their adoption.

PHILCO CORP., *Philadelphia, Pa.*

MARCH 23, 1953.

The CHAIRMAN. The committee will stand adjourned.

(Thereupon, at 12:55 p. m., the committee adjourned.)

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COLOR TELEVISION

TUESDAY, MARCH 31, 1953

HOUSE OF REPRESENTATIVES,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C.

The committee met at 10 a. m., pursuant to adjournment, in room 1334, New House Office Building, Hon. Charles A. Wolverton (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

STATEMENT OF HON. PAUL A. WALKER, CHAIRMAN, FEDERAL COMMUNICATIONS COMMISSION, WASHINGTON, D. C.

The CHAIRMAN. Today we have the privilege of listening to the distinguished chairman, Mr. Paul A. Walker, Federal Communications Commission.

On March 27 I communicated with Mr. Walker giving some indication of some matters that the committee would be interested in hearing him discuss, but in no way limiting him or suggesting that he confine himself to those particular questions; but in order that the committee may have some understanding of the matter, I will read at this time a letter which I addressed to him.

HOUSE OF REPRESENTATIVES,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C., March 27, 1953.

Hon. PAUL A. WALKER,
Chairman, Federal Communications Commission,
Washington 25, D. C.

DEAR CHAIRMAN WALKER: As you know we have been conducting hearings this past week on the subject of color television in an effort to determine just how soon the public may have color television in their homes, and have heard from a number of witnesses from industry.

It would seem most appropriate at this juncture for your Commission to appear on this matter and to comment upon the testimony which has been given. I understand that it will be convenient for you to do so this coming Tuesday, March 31, 1953.

In the comments which you make, I trust that you will cover, among other subjects, the suggestions which have been made by several witnesses as to ways in which the ultimate consideration of the standards proposed by the NTSC might be expedited. I have in mind such specific recommendations as those made today by Mr. W. R. G. Baker that—

(*a*) The Commission relax its present restrictive policy to permit wider broadcasting of the proposed NTSC signal on an experimental basis; and

(*b*) The Commission designate some of its staff to follow and participate in the series of tests being conducted by NTSC with a view to perceiving their conformity with the criteria for color telecasting set up by the Commission so that there may be savings in time in such eventual proceedings as the Commission may conduct on an application for the use of this system.

Knowing of your continuing interest in encouraging the earliest possible availability of color television in the American home, I hope that in your comments you will be able to suggest other ways in which the requisite formal proceedings may be telescoped without impairing the reaching of a decision in the public interest.

Sincerely yours,

CHARLES A. WOLVERTON, *Chairman.*

You may proceed, Mr. Walker.

Commissioner WALKER. Thank you, Mr. Chairman.

My name is Paul A. Walker. I am Chairman of the Federal Communications Commission. During the course of the last few days, you have heard a number of viewpoints expressed concerning the color-television situation. In one way or another, the testimony of each of the witnesses has made considerable reference to the Federal Communications Commission. I appear here in response to the request of your committee to discuss with you in some detail the role of the Commission in this matter.

As you are aware, the Commission has inquired quite extensively in recent years into the problems of color television. Our inquiry and study has included both formal hearings and the assembly of data through less formal processes. And, as you know, we have heard thousands of pages of testimony on the subject—much of it from the same groups that have appeared here. For example, let me read to you from a statement made to the Commission in behalf of the Radio Corporation of America.

We firmly believe that with the development of its all-electronic, high-definition, compatable color television system and its tricolor tubes, RCA has shown the way for the adoption of color standards now. We recommend that the Commission set color-television standards based on the RCA color system.

This statement was made to us 3 years ago in early 1950 by David Sarnoff, chairman of the RCA board of directors in the course of our most recent color television hearing. However, when the color television system referred to by Mr. Sarnoff was examined critically and objectively by the Commission in public hearing, it failed to meet even minimum reasonable standards for an acceptable color system. Without attempting to list all of its faults, I might point out that it produced an unsatisfactory color picture—it required receiving equip ment too complex for the public to operate and too costly for it to buy—and it required certain other equipment of such complexity that there was no sound basis for considering it practical for regular commercial use.

RCA has again announced the advent of the millenium in the field of color television, and it asserts that we should without further ado accept its word for this and immediately authorize the system it now advocates—all this without the completion of field test and without affording others the opportunity to participate or to propose competing systems. Apparently, the engineering standards now urged by RCA are those recently formulated by the National Television System Committee (NTSC).

On last Friday, Dr. W. R. G. Baker, chairman of the NTSC, appeared before you and among other things emphasized the fact that the standards tentatively adopted by NTSC are now in the process of being field tested. He urged strongly that the Commission not

approve the NTSC tentative standards until they have been thoroughly field tested and stated:

> * * * I cannot stress too strongly the need for a thorough examination of the scientific points of this system. Sir, you are setting standards which last for a lifetime or more than a lifetime. Things happen—and I think that the NTSC is made up of the best engineers in the industry—but they make mistakes. There is a great deal of difference between theory and practice and we in the laboratories and on pieces of paper, can lay out beautiful theories which can be exploded by actual experimentation. * * *

Statements submitted by others who have appeared here, also participants in the NTSC, reiterate and support this view—and we heartily agree.

We would be the first to recognize, Mr. Chairman, that a color television system different from the one adopted by the Commission may now have been developed. It may even be a better system. It may be that the color quality is excellent. It may be that the required receiving and other equipment is practical for everyday use and for commercial production. It may be that the cost involved would not put it beyond the reach of the general public. It may be that it is not unduly susceptible to interference. Indeed, it may be a system that the Commission should approve as the basis for its color television standards. But the fact is that this has not yet been demonstrated. And because it has not yet been demonstrated—because these possibilities have not been established as realities—it also may not be all that its proponents hope for it. And, as the chairman of the NTSC itself has made clear, a sound judgement cannot be made until data is available based upon essential field testing. It must be remembered that field testing of the revised NTSC standards began only this month.

I have started my statement in this manner, Mr. Chairman, to highlight the complexity of the color television matter, the greatly varying viewpoints that exist, and to emphasize, as strongly as I can, the fact that the answers are not simple and clear.

At the same time, let me also make it clear that the Commission remains convinced of the importance of color in the future of television; and that the record of the Commission in this field—actions as well as words—has been one designed to promote the advent of color television on a regular basis.

Let's look at the record.

Color television systems were considered by the Commission in a public hearing as early as January 27, 1941, when the Commission received evidence concerning television standardization in the very high frequency band. Shortly thereafter—on February 27, 1941—the Commission issued a public notice setting forth proposed standards for both monochrome and color television. The hearing on this proposal was held March 20–24, 1941. On May 3, 1941, the Commission issued its report on these hearings and on the same day it released the order, which adopted the first commercial television rules and regulations and standards for monochrome or black-and-white transmissions. The Commission's order did not establish color standards, but set forth tentative conclusions with respect to certain engineering standards—criteria—for experimental field testing of color transmission and further provided that "on or before January 1,

1942, the licensees of television broadcast stations shall submit to the Commission complete comparative test data on color transmissions. with recommendations as to standards that may be adopted by the Commission for color television." However, the demands of the national emergency and war which followed prevented the industry from proceeding with color television experimentation to the extent that would have been possible in normal times.

Testimony on color television was again presented to the Commission in the 1944–45 general allocation proceeding in docket 6651. The proposed report of the Commission, issued January 15, 1945, and the final report of the Commission, issued May 25, 1945, in that docket in general, reaffirmed the standards for monochrome in the VHF band. The ultrahigh frequency band was allocated to television experimentation for the purpose of developing color television and high definition monochrome television.

The Commission was requested for the first time to promulgate commercial standards for color television in a petition filed by CBS on September 27, 1946. The CBS proposal requested the commercialization of color television in the UHF band, using a field sequential system with 525 lines and 144 fields, and utilizing wide band channels of 16 megacycles.

The hearing on this proposal was held between December 3, 1946, and February 13, 1947. Although the CBS system was the only one formally proposed to the Commission for adoption, RCA advanced for consideration a so-called simultaneous system, disclosed to the public on October 31, 1946, which RCA stated would be ready for commercial standardization and marketing within 4 to 5 years. The report of the Commission, issued March 18, 1947, denied the CBS petition, saying in part:

> * * * The Commission is of the view that the standards for color television proposed by Columbia Broadcasting System should not be adopted. In the Commission's opinion the evidence does not show that they represent the optimum performance which may be expected of a color television system within a reasonable time. The Commission bases this conclusion on two grounds. In the first place, the Commission believes that there has not been adequate field testing of the system for the Commission to be able to proceed with confidence that the system will work adequately in practice. Secondly, the Commission is of the opinion that there may be other systems of transmitting color which offer the possibility of cheaper receivers and narrower band widths that have not yet been fully explored. * * *

The next significant consideration of the color television problem came on July 11, 1949, when the Commission instituted further rulemaking proceedings which included issues with respect to color television. The hearing on these color issues was held before the Commission en banc commencing September 26, 1949, and ending May 26, 1950—a total of 62 hearing days, covering 9,717 pages of transcript and including extensive demonstrations of the system which had been proposed. These proceedings resulted in the adoption on October 10, 1950, of standards for color television based upon the field sequential system which had been proposed by the Columbia Broadcasting System. Because of the length of the Commission's final reports I do not suggest that they be included in the record of your proceedings. However, I would like to make them available to the members of this committee for their consideration.

There has been considerable testimony before this committee with respect to the Commission's color decision. Under the circumstances,

I think you will want to know how and why we reached that decision.

There is no mystery concerning this. In fact, the considerations were set forth succinctly in paragraph 121 of our September 1, 1950, report. It reads as follows:

> Because color is such a fundamental improvement in television, the Commission is of the opinion that in establishing standards, a system must be chosen that produces a satisfactory color picture and is capable of operating through apparatus that is simple to operate in the home and is cheap enough in price so as to be economically available to the great mass of the American purchasing public. The Commission is of the firm opinion that it would not be in the public interest to establish a television system where only black-and-white receivers are cheap enough for the great mass of the American people and color television is available to those who can afford to pay luxury prices.

We think these principles are equally applicable today.

And, today—we have the same conviction with respect to the specific criteria we relied upon for judging the color system proposed. They are set forth in paragraph 122 of our report. It has been asserted that these criteria—which also would be used in the evaluation of any new system—are unduly restrictive and burdensome. We have been unable to find, however, any testimony in this hearing indicating why these requirements are too restrictive. And no one has come to the Commission and told us why they are too restrictive or how they should be changed in any particular way. I strongly suspect that this failure of anyone to come forward is not attributable to any natural reticence or unwillingness on the part of the industry to tell us we are wrong. I think they have not come forward because the criteria and the requirements which we have provided are demonstrably sound and reasonable from the viewpoint of protecting the interest of the public.

Dr. Baker read several of the requirements to the committee last week, but didn't explain why he thought they were inappropriate. I should like to read the entire list to you. And I might add that we believe that they constitute a perfectly reasonable basis for judging the merits of a color television system—particularly when it has been demonstrated by at least one system that they can be met.

These are the criteria:

> (*a*) It must be capable of operating within a 6-megacycle channel allocation structure.
>
> (*b*) It must be capable of producing a color picture which has a high quality of color fidelity, has adequate apparent definition, has good picture texture, and is not marred by such defects as misregistration, line crawl, jitter, or unduly prominent dot or other structure.
>
> (*c*) The color picture must be sufficiently bright so as to permit an adequate contrast range and so as to be capable of being viewed under normal home conditions without objectionable flicker.
>
> (*d*) It must be capable of operating through receiver apparatus that is simple to operate in the home, does not have critical registration or color controls, and is cheap enough in price to be available to the great mass of the American purchasing public.
>
> (*e*) It must be capable of operating through apparatus at the station that is technically within the competence of the type of trained personnel hired by a station owner who does not have an extensive research or engineering staff at his disposal and the costs of purchase, operation, and maintenance of such equipment must not be so high as unduly to restrict the class of persons who can afford to operate a television station.
>
> (*f*) It must not be unduly susceptible to interference as compared with the present monochrome system.
>
> (*g*) It must be capable of transmitting color programs over inter-city relay facilities presently in existence or which may be developed in the foreseeable future.

In the final color proceedings before the Commission in 1949 and 1950, we weighed and evaluated the three color systems that were advanced for our consideration on the basis I have just indicated.

The field sequential system was the only one that measured up to these standards. Neither the Radio Corporation of America nor the Color Television, Inc., proposals measured up to these standards. As I have indicated, they were found deficient not only in the quality of the color picture that they produced, but necessary equipment was found to be so complex that there was no assurance it could be produced at reasonable cost or that it would be practical for regular commercial use.

One further problem remained however. It was the problem posed by the incompatibility of the field sequential system—and the alleged compatibility of the RCA system. Compatibility as the term has been used has reference, it should be stressed, not to the question of whether existing sets could receive pictures in color, but rather to their ability to receive color transmissions—in black and white—without any modification.

The problem posed by compatibility was both vexing and perplexing. The Commission faced the issue squarely. Its conclusions was stated in paragraph 123 of its report:

> The Commission is of the opinion that if a satisfactory compatible system were available, it would certainly be desirable to adopt such a system. Compatibility would facilitate for the broadcaster the transition from black and white broadcasting to color broadcasting and would reduce to a minimum the obsolescence problem of present receivers. However, as will be developed more fully later on in this report, no satisfactory compatible system was demonstrated in these proceedings and the Commission is of the opinion, based upon a study of the history of color development over the past 10 years, that from a technical point of view compatibility, as represented by all color television systems which have been demonstrated to date, is too high a price to put on color. In order to make these systems compatible, the alternatives have been either an unsatisfactory system from the standpoint of picture quality, or a complex system, or both. A complex color system will have such formidable obstacles in its path that there is no assurance it would be acceptable to the American public. The Commission is compelled to reach the conclusion that no satisfactory compatible color system has been developed.

Let me make clear that those of us on the Commission who joined in the Commission's majority opinion in 1950 do not believe that even hindsight shows we are in error in adopting the field sequential system. It, and it alone, afforded an available, adequate, simple and relatively inexpensive method of securing color television. The Commission was unanimous in its views concerning the deficiencies of the systems that were rejected.

In adopting the field sequential system, we recognized that if at some future date, another system was developed, we would be under an obligation to give it consideration. We recognized this expressly. We provided that any new system which might be presented to us would be reviewed in the light of the basic criteria that I have described to you. And, like Dr. Baker in his testimony before this committee, we pointed out the importance of adequate field testing. We provided a well-defined procedure for interested persons to follow should they desire a review of the color standards we adopted. It must be emphasized that, contrary to a belief which has been expressed here, the provision for considerations of new systems that might be

developed in the future was not motivated by any lack of confidence in the system we adopted. The procedure was motivated solely by a recognition of the dynamic nature of the radio art and our responsibility—at all times—to consider in an orderly fashion new developments.

Thus far, I have covered the highlights of the past events in this field. I have endeavored to tell you what we did and why we did it. Now, I would like to address myself to some of the specific matters that have arisen in the course of the testimony presented to this committee.

It has been suggested that the Commission could, and should, abandon its adherence to a single standard for color transmissions and authorize the broadcasting of color not only on the basis of the field sequential system, but also on the basis of the latest system urged by RCA—and presumably any other compatible system for broadcast in color. It is argued that, in this way, "the American public would make the final decision as to the system it prefers." Even if it is assumed that an allegedly compatible color system will not degrade the quality of black and white transmissions—and at this point I do not assume it—this suggestion is fundamentally unsound.

Superficially, the suggestion appears to be one which would promote competition, and appears to leave to the public the choice of selecting the preferred system, just as a member of the public is free to choose the automobile of its choice from among those of many manufacturers. But the field of radio cannot be likened to the automobile business. If you buy any car of your choice, it will take you anywhere on the highways of the world. Not so with the radio receiver. If you buy one that can only receive a certain type of technical transmission, you are unable to receive other transmissions.

Thus, as a member of a listening audience you are shut off from other stations, or to use the automobile analogy, from certain highways. If five stations in your town are using five different standards, and manufacturers have sold five different kinds of receivers, there will be in effect five different listening or receiving audiences. Such a result would completely destroy the fundamental competitive basis upon which broadcasting was intended by the Congress to operate. For it will mean, not that each broadcasting station would be serving the entire available listening or viewing audience in the community, but only a part of that audience. It would mean, therefore, that the five broadcasters in our illustration would not be competing with each other for audience because each has its separate audience, and each would have in effect a monopoly of the attention of its audience. It would mean that programming choice could be exercised by a listener or viewer only by incurring the additional expense of additional receivers or attachments.

In the final analysis, public choice from among several color systems becomes a snare and a delusion. For, it deprives the public of the real freedom of choice in programming which is the cornerstone of our American system of broadcasting. By the same token, it destroys the very basis upon which broadcasting may be operated on a truly competitive manner. In the same connection it should be pointed out that the so-called Condon committee (Senate Advisory

Committee on Color Television to the Senate Committee on Interstate and Foreign Commerce) stated in its report:

* * * Any authorization of color television transmission on a multiple-standards basis is a guaranty of confusion that may well impose a much greater delay in the development of the color-television service. The committee concludes that one and only one of these systems should be licensed for service to the public and that therefore the decision among the dot, line and field systems must be made in advance of the introduction of a color-television service.

And finally, it must lend inevitably to a most inefficient and even wasteful use of all-too precious radio spectrum.

The question has been asked whether NPA Order M–90 was the result of a deal or "play" between the NPA and the Federal Communications Commission. The answer is no.

We had hoped that by the operation of our own processes in approving an admittedly ready system, at least some portions of the industry would manufacture sets and the forces of competition would cause others to follow suit. Indeed, so concerned were we that forces other than natural competitive forces might have been at work within the industry keeping some manufacturers from making color sets that we referred to the Department of Justice for consideration the possible effect of the patent situation and patent practices in the industry upon this problem.

Dr. Baker, Chairman of NTSC, presented a number of recommendations of the NTSC to your committee. I should like to address myself to each of those recommendations.

First, NTSC recommended

* * * that the Federal Communications Commission formally recognize the existence of the NTSC and lend its active support to the NTSC program.

In this connection, Dr. Baker read the contents of a letter which he sent me on December 16, 1952, relating to the role of NTSC in the development of color. He testified that he was disappointed at my reply but did not read that reply to you. I should like to do so at this time:

Dr. W. R. G. Baker,
Chairman, National Television System Committee
General Electric Company, Electronics Park,
Syracuse, New York.

Dear Dr. Baker: I have your letter of December 16, 1952, urging what is termed a fresh, informal approach to the problems presented by color television. You state that since the close of the color hearing in 1950 major technical progress has been made in this field, and that the scientists and engineers responsible for this progress have participated in the work of your National Television System Committee. You suggest, therefore, that the Commission might obtain the benefit of these advances in the art by inviting NTSC to make an informal report to the Commission. Such an invitation by the Commission at this time, you submit, would eliminate the element of controversy. You state that a formal hearing on color is not proposed at this time because such a hearing would tend to produce controversially framed issues.

The Commission appreciates your interest in presenting your views and suggestions on this matter to the Commission for consideration. As you know, the Commission has at all times expressed its desire that it be kept informed of the latest developments in the color field by means of your various reports and demonstrations. As you will recall, in its letter to you of June 26, 1951, in response to your inquiry whether the Commission would designate members of its staff as observers at your committee meetings, the Commission was of the view that it could best remain informed of your progress if you would continue to send for our information copies of the documented material published by the NTSC, and if you would from time to time advise us in advance of special demonstrations or meetings that might be of particular interest to members of

the Commission and its staff. The Commission, along this line, has designated several staff members to witness a number of your demonstrations. We believe that this arrangement has worked out satisfactorily and should be continued. Material submitted by your group, whether it be in the nature of an informal progress report such as that referred to in your letter or of a different nature, will continue to receive our careful review.

The Commission is of course aware that further extensive color television experimentation has been undertaken since the adoption of the field sequential system, both by your committee and others. Continued research and experimentation in such a dynamic field of electronics was contemplated and welcomed by the Commission; indeed, in its second color report, the Commission recognized that new color systems might receive formal Commission consideration. At such time as your committee is prepared to present a new color system to the Commission, you may be assured of the Commission's most careful consideration. However, until your research has reached the stage where a formal proposal may be forwarded, it is felt that the present arrangement is the one best designed to provide for the submission of such material as you may consider appropriate on a less formal basis.

I want to thank you again for your interest in raising this matter and for your helpful cooperation. I might add that I have informally discussed this matter with my fellow Commissioners, and I believe the above also represents their views on this subject.

Sincerely yours,

PAUL A. WALKER,
Chairman.

I'm sorry that Dr. Baker was disappointed with this reply, but I think it sets out very clearly a reasonable and appropriate approach to the questions he had raised. And I think it indicates beyond question that the Commission does recognize both the existence of the NTSC and the efforts which it is making to develop a satisfactory color system.

But just to be sure that there is no doubt on this matter let me add that long before Dr. Baker wrote me the Commission had recognized that NTSC is a group of representative manufacurers of electronics equipment organized by the Board of Directors of Radio Manufacturers' Association; that it stated purpose with respect to color television is to assemble technical data on "basic standards for the development of a commercially practicable system of color television and to undertake additional work as may be in the interest of providing more adequate television service to the American public;" that it has devoted a substantial amount of time, money, effort, and engineering talent to the accomplishment of its stated purpose; that it has standing to request the revision of the Commission's standards; and finally, that any proposal which it advances to the Commission will receive the most careful and objective consideration. We do not recognize—and I cannot conceive that Dr. Baker's recommendation intended that we recognize, that the NTSC is entitled to any special recognition over other industry groups; that the Commission is committed in advance to an endorsement of future NTSC findings and conclusions; or that the Commission should abdicate in any way to the NTSC the exercise of its judgment, critically and objectively, as to the public interest.

As you will note, Mr. Chairman, the Commission has maintained an interest in the NTSC experimentation, has asked that it be advised of demonstrations that might be of particular interest to the Commission. And, in fact, we have received written documentation and have attended demonstrations. Now that the NTSC work has reached the point of actually field testing a possible new system, we will, of course, make arrangements to observe their tests. And, as you have suggested, in your letter to me, this may possibly have the effect of saving some

time in any further proceeding that may be instituted to consider the NTSC data. But I must add a word of caution. Until we have the full data and information concerning the conditions under which the tests are conducted and until we can consider matters such as the necessity for side-by-side comparison of pictures resulting from different systems of transmission, it is impossible to tell just how much time can be saved.

The NTSC next recommended that:

> Nothing be done to interfere with the completion of the current field testing program.

Dr. Baker explained the basis for this recommendation. He stated that he was fearful that:

> * * * all of a sudden the FCC would say the NTSC has an acceptable system of color television and therefore it is commercially licensed * * *

Let me assure the committee that for the reasons I have discussed there is no basis for his concern on this score.

Their next recommendation was:

> That the FCC relax its present restrictive policy in order to permit and encourage earliest and widespread broadcasting of the proposed NTSC signal on an experimental basis.

In his testimony Dr. Baker stated:

> I must say to be fair, that in the case of specific requirements, the FCC has given us 15 minutes at stated intervals for certain periods of time; given permission to do that. We would like it extended.

And I must say that to be fair Dr. Baker should have said a great deal more. The record will establish that the Commission has been quite cooperative in the issuance of authorizations for experimentation in color. The industry has not been limited to 15 minutes, to 30 minutes, to hours, or to days.

It is perfectly true that color television experimental operations are required to be conducted on a more restrictive basis than color television broadcasts under commercial licenses. But in referring to a "present restrictive policy," Dr. Baker gave the impression, perhaps unwittingly, that the Commission has singled out color television experimentation on the NTSC or other compatible systems for discriminatory and unreasonable treatment. This is not at all the case.

Our experimental rules, whether they apply to experimentation for color television or experimentation for electronic navigation aids, are designed to guard against commercial exploitation of a particular system, to the possible detriment of the public, before that system has been approved and authorized on a regular basis. This is especially true with respect to a system of transmission to the general public, where the public might be misled into a belief that the experimental operation has received final governmental authorization.

We do not have jurisdiction over the sale of receivers to the general public. But we do have the duty and the responsibility to prevent the conduct of experimental tests of unproved transmission systems in a manner that premature widespread purchase of receivers might be encouraged. And since we have no direct control over the sale of receivers, some manufacturers—and not necessarily those conducting the experimental operations—might seek prematurely to exploit the sale of receivers. The result eventually may be that those receivers might become useless, if that particular system is not approved. Or

if there has been a widespread sale of receivers in that system, the Commission would be confronted with demands that our standards accommodate the continued use of such receivers.

These fears are not at all fanciful. We have learned from experience that some interests in the industry are not unwilling to "jump the gun" by utilizing experimental operations as a device to exploit the sale of sets. Many of you gentlemen will recall that in 1940, at a time when great controversy still existed as to the proper standards to be approved for black and white television, the Commission relaxed the limitations on experimentation and permitted what was described as "limited commercialization." Some of you may recall that in order to prevent this practice, we found it necessary to withdraw this action because of the vigorous campaign for the sale of television receivers operating in one of the competing systems which certain manufacturing interests had begun to carry on.

I do not for a moment suggest that any such motive underlies the NTSC recommendation. However, with all due regard for its commendable objectives, our policies on a matter with such important implications to the public must be based on the sound considerations underlying our experimental rules—and which we must apply to all experimenters on an equal basis.

But, in case I have led you to think that experimentation in color television has been or will be in any wise hampered or unfairly restricted, I will supply for the record a detailed statement showing the large number of authorizations which we have issued which permit experimentation with compatible systems of color television. And I would like to point out in this connection that we have even held open to experimenters with compatible color television the opportunity to utilize commercial-television facilities during regular broadcasting hours—but under specified conditions designed to assure against the dangers to which I have referred. Thus on June 25, 1952, in reply to a letter from Dr. C. B. Jollife, vice president and technical director of RCA, the parent organization of NBC—which of course is a member of NTSC—the Commission stated that:

> As you state in your letter, the Commission has up until now maintained a strict policy against permitting experimentation with compatible color-television systems during regular broadcasting hours. In general, we believe that this policy ought to be maintained. It is recognized, however, that deviations from this policy will be necessary on occasion in order to permit full-scale experimentation and field testing. The Commission will consider on a case to case basis applications for experimental authorization during regular broadcast hours upon a showing that such experimentation is necessary in light of the individual field tests contemplated. Any such application must describe in detail the nature of the field test and state exactly why such field test cannot be accomplished at other than regular broadcast hours.

I believe, Mr. Chairman, that the material just given you will clarify any question that may have arisen as a result of Dr. Baker's recommendation that

> The Commission relax its present restrictive policy to permit wider broadcasting of the proposed NTSC signal on an experimental basis.

The NTSC has been permitted to make full use of experimental authorizations provided for in the rules governing experimentation. And we have stated our willingness to permit experimental transmissions, even during regular broadcast time upon appropriate showings that the needs of experimentation required such authority. Since

last June several requests for this type of authorization have been received; all of them were granted. We are firmly convinced that this approach has been a real protection to the public and at the same time has afforded NTSC full opportunity for experimentation in color.

Now, Mr. Chairman, let me leave the past and turn to the present and future. What of the present situation with respect to color television? There is no broadcasting in the field sequential system, and no manufacture of equipment for it. And insofar as we are aware there are no current plans by the industry to proceed with it. Does this mean we should scrap our existing standards? Or conversely, should we require that all television licensees broadcast all or a specified percentage of their programs in the approved color system? We think the answer to both of these questions at this point is no.

We are presently faced with statements that a compatible system has been developed which produces a good color picture and that it will very shortly be ready for standardization. We think it apparent that, under such circumstances, it would not be in the public interest for the Commission to take any action at this time either to scrap or push the existing field sequential system until we have had an opportunity to evaluate the new proposal if it is presented in the fairly near future. The compatible system may produce the satisfactory color picture its advocates claim for it, and in other respects be ready for standardization. On the other hand, we must be realistic enough to recognize that the new system may upon an examination fail to meet minimum standards as its predecessors have. In such circumstances we will have before us the difficult policy question whether the public interest in making color available outweighs temporary but substantial inconveniences which might result from the transition to the field sequential system.

There are, of course, other possibilities. New systems may fall short of absolute success or complete failure. And I think it is clear that it is impossible for us to state definitely now how we would react to the various factual situations with which we might be presented. But we believe that the imminent possibility that a new system may be presented to the Commission for its consideration makes unwise any early action by the Commission in the interim.

In this connection, the record of this hearing contains considerable comment upon the question of possible hearings—their length and complexity—that may be required if a new color-television system is proposed. For the reasons which I have already set out, I shall not spend more time on the suggestion that further rule-making proceedings would be unnecessary, and that all the Commission has to do is issue a statement that anyone who wishes to broadcast in color on a regular commercial basis may do so.

Let me assume, however, that the NTSC or some other system is developed in the near future to the degree that its proponents believe it is ready for standardization. Would we have to go through a long proceeding before we could incorporate such standards in our rules? I don't think so, and I hope not. But the answer is not entirely within our control.

As we indicated most of the time in the last color proceedings was spent in receiving oral testimony, not in the Commission's deliberations after the record was completed. In fact, after the record in the

last color proceeding was closed only 3 months elapsed before the Commission announced its decision. It was the actual hearing time—62 days over a 9-month period—that dragged things out. And that was almost inevitable in a situation where you had three bitterly contesting groups all claiming that their system alone should be adopted by the Commission. The result was a situation in which almost no factual statement went unchallenged, and it was impossible in the absence of full hearings to establish the necessary factual basis for the Commission's decision.

If in any future proceedings we again are confronted with several basically different and competing systems, then the proceedings almost certainly will not be as short as you and we would like to have them. If on the other hand there is only one proposal before us, we think you can be sure that there would be an appreciable saving in hearing and decision time. But I don't want to give the impression that even in such circumstances our consideration of such a proposal could be a perfunctory one. The system would have to demonstrate its capabilities under situations approximating actual operating conditions. And we would also require adequate proof of the ability of the system to meet the other basic criteria of a proper color system before we could consider substituting it for the existing standards.

However, we are not starting from scratch. We have as useful guideposts our past experience in the field and the extensive technical knowledge acquired in the course of the earlier proceedings. We also know the kind of criteria that should be used in judging the acceptability of a system. And to the extent that the systems now being experimented with stem from previously rejected systems both the industry and the Commission are aware of the particular areas in which improvement is required. All of these factors lead me to hope that any new proceedings could be completed in substantially less time than those conducted in 1949. But as I have indicated, the principal factors determining the answer to this question will be the extent to which there is opposition to or competition with any system advanced for our consideration and the extent to which any such system is shown to achieve that degree of excellence which would warrant its acceptance as the basic color television standard.

Let me say a word in conclusion. This committee is most properly concerned with the failure of the American public to have color television today and with the public confusion as to the whys and wherefores thereof. I think we will all agree that Government should not add to that confusion.

A decision on color is one that may be with us for generations to come. Congress has provided an orderly process by which the decision on behalf of the public interest on this important question shall be made. Already, the question has received long and serious deliberation to be sure that the public will be given the correct answer. In fact, each arm of the Government has, in a broad sense, participated in these deliberations including the highest Court in the land. If that answer is found tomorrow to require revision in the light of changing conditions, we are fortunate that our governmental processes are adjustable to meet the demands of the public interest. But we say to you with all the force at our command, that as we have found

from experience, short cuts to a commendable objective frequently are blind alleys or dead-end streets.

And we say that any system of color television which is to be with the public for years merits the most serious governmental deliberation. These deliberations should not and need not be interminable, but they should assure the public that all persons having a worthwhile contribution to make to a correct answer should have the opportunity to be heard.

Mr. Chairman, I thank you.

The CHAIRMAN. Any questions, gentlemen?

Mr. HINSHAW. Mr. Chairman.

The CHAIRMAN. Mr. Hinshaw.

Mr. HINSHAW. Mr. Walker, you referred very briefly, and somewhat sketchedly to Order M–90. Was the Commission consulted bebore the issuance of that order?

Commissioner WALKER. It was not.

Mr. HINSHAW. How do you account for that?

Commissioner WALKER. Well, Mr. Hinshaw, I don't account for it except that the Department which issued the order was exercising what it considered to be a proper function and I assume that it may not have needed the advice of the Federal Communications Commission.

The order, as I am advised, concerned the use of materials and it was based on that alone and not on any advice which the Commission might have given it as to the value or lack of value of color television and of the particular system involved.

Mr. HINSHAW. Do you know of any materials which would be used to manufacture color television equipment that are not used in the manufacture of black and white equipment?

Commissioner WALKER. Mr. Hinshaw, my answer would be, so far as I am advised, no; but I would rather not be quoted as an authority on materials. I leave that to the NPA. We are not given jurisdiction over materials.

Mr. HINSHAW. Now, you mentioned in your first statement, and again rather briefly, that as a result of certain procedure you have made recommendations to the Department of Justice. Will you elucidate and elaborate on that subject?

Commissioner WALKER. Well, questions were raised from time to time as to whether color television could have been held up by certain equipment which was patented.

Mr. DOLLIVER. Pardon me, but I did not get that.

Commissioner WALKER. By the patent situation.

Mr. DOLLIVER. Excuse me; I just did not quite hear you.

Commissioner WALKER. Now, if there were violations of the law affecting monopoly, the Department of Justice, of course, would be the place to make the inquiry and if prosecutions were necessary to conduct the prosecution. So, the patent situation having been raised, we referred the matter to the Department of Justice, for it to make such inquiry as it deemed necessary to ascertain whether there were violations of the laws and whether the patent situation controlled by one or more manufacturers and broadcasters had anything to do with the delay.

Mr. HINSHAW. Have you any objection to entering in the record your letter of transmittal of that subject to the Department of Justice?

Commissioner WALKER. No; I have no objection. I assume that there is no objection. The only thing, Mr. Hinshaw is, it is a delicate situation to take a matter that you have referred to the Department of Justice and handle it without consultation from the Department of Justice. I would prefer that we consult with the Department of Justice. I have no objection to giving you the letter. I would be glad to do it.

Mr. HINSHAW. Well, my information is that the Department of Justice instituted a grand jury proceedings, which it broke off, or did something to on the 19th of January of this year. Do you know about that?

Commissioner WALKER. No; I am not advised.

Mr. HINSHAW. One more question.

Mr. HARRIS. Will the gentleman yield?

Mr. HINSHAW. Yes.

Mr. HARRIS. Is that in connection with the order M–90?

Mr. HINSHAW. No; that is in connection with the patent situation.

Mr. HARRIS. Affecting television and radio?

Mr. HINSHAW. Yes.

This recommendation of Dr. Baker, No. 5:

5. That upon satisfactory completion of the field test the NTSC color standards be adopted by formal order of the Commission based on procedures similar to those followed by the Commission in establishing monocrome standards in 1940–41.

Do you understand that to mean that it should not go to a formal hearing?

Commissioner WALKER. Well, I think we could hardly have the question before us of a formal hearing at this time. I would not know until we got the data.

Mr. HINSHAW. What were the procedures that were followed by the Commission in establishing the monocrome standard in 1940–41?

Commissioner WALKER. We had the hearings on the specifications and requirements.

Mr. HINSHAW. Then you see no difference between his recommendations, No. 5, and the normal procedures of the Commission?

Commissioner WALKER. Except that we have a lot of information which it would not be necessary to repeat in the record. We would start from where we are rather than going back to the beginning. When we were first establishing television we, of course, were starting from scratch; had to consider everything.

Mr. HINSHAW. That is all, Mr. Chairman.

Mr. HARRIS. Mr. Chairman.

The CHAIRMAN. Mr. Harris.

Mr. HARRIS. Mr. Walker, I want to compliment you on a very forthright outstanding statement, giving the position of the Commission thus far in this highly technical and involved matter of color television. I recognize that you have stated that there are several groups outstanding in this country in their field of scientific endeavors that are striving to the very best that they can to obtain results toward serving the public and it is the responsibility of the Commission, as I see it, because of the importance of this problem to be sure, insofar as possible that they are right when they make the final decision. I recognize that that is a terrific burden on the Commission.

I should like to ask in that connection if the action taken by your Commission was unanimous.

Commissioner WALKER. No.

Mr. HARRIS. Can you give the committee information as to the division of opinion in the Commission?

Commissioner WALKER. Miss Hennock, I believe——

Mr. HARRIS. I don't necessarily mean to give the names—one from each side. I thought numerically would be sufficient.

Commissioner WALKER. I will continue on with that statement inasmuch as I have commenced.

Mr. HARRIS. That is perfectly all right if you feel you should.

Commissioner WALKER. She thought that we should have found a compatible system. I believe that was her viewpoint.

Now one or two of the other Commissioners were—at least one other Commissioner, I think was influenced along that line. I am not sure but that one of the Commissioners thought that perhaps we could start with the system which RCA had presented, or some other system closely approximating it.

I would rather supply for the record, however, the views of these Commissioners.

Mr. HARRIS. That is perfectly all right for you to do so. The point of view——

Commissioner WALKER. The points of view. I think that you have the decision in the record, with some of the documents that we have filed.

Mr. HARRIS. The point is that you were not anything like unanimous in the decisions that you have made thus far?

Commissioner WALKER. Well, I would not go quite that far. I said there were some dissents on the Commission. There was a majority.

Mr. HARRIS. And very likely some of the dissents could have been to certain particular problems or issues in connection with it.

Commissioner WALKER. That is right. There was no dissent on the question of the advisability of color. Everybody wanted to get color and wanted to get color started as quickly as possible. Most of us thought that when we did start color we should be sure that we were right, so that we would not have to back up and start all over again.

(Mr. Walker later furnished the following information:)

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON 25, D. C., *April 6, 1953.*

Hon. CHARLES A. WOLVERTON,
Chairman, Committee on Interstate and Foreign Commerce,
House of Representatives, Washington 25, D. C.

DEAR CHAIRMAN WOLVERTON: In my recent testimony on color television before your committee the question was raised whether the Commission's action adopting the field sequential system of color transmissions was unanimous. In pointing out that two Commissioners dissented from our final action it appears that I did not make clear the position Commissioner Sterling took on this matter. In order, therefore, that the record may reflect clearly Commissioner Sterling's position, I want to take this opportunity to set out more fully the basis of his dissent.

Commissioner Sterling in his dissent to the second report did not favor the immediate adoption of any particular color television system. As you will recall, the Commission issued its first report on September 1, 1950, proposing the establishment of what are known as "bracket standards." This report rejected the RCA and CTI systems. However, the Commission stated that before adopting the incompatible CBS system it wished to determine whether "bracket stand-

ards" would be a practicable means of maintaining a status quo on the compatibility question. The Commission stated that if "bracket standards" should prove not to be a workable solution, it would thereupon adopt the field sequential system.

Commissioner Sterling joined with the majority in its first report. His decision was made on the understanding that if the assurances from manufacturers concerning the incorporation of "bracket standards" in their receivers were inadequate or insufficient, the Commission then would issue a final decision adopting the CBS field sequential color system.

On October 10, 1950, the Commission upon determination that there was no possibility of immediate adoption of "bracket standards" issued its second report on color adopting the CBS field sequential system, and Commissioner Sterling dissented from this action. It was his view that the action taken by the Commission adopting field sequential color standards at that time was premature. Commissioner Sterling felt that provisions allowing for a reasonable additional period of time for the investigation by manufacturers of the practicability of incorporating "bracket standards" would have afforded the Commission "* * * the experience of industry in this new concept of field and line scanning." Further, he stated that in this way the Commission "would be able to better judge what it would cost the public and if it would provide the avenues for improvement that might be made in the art." He suggested that much could have been accomplished if a 2-day conference had been called with those members of the industry who had indicated a willingness to cooperate with the Commission for the purpose of exploring further "bracket standards." However, he made clear that if such a conference did not result in a practical solution of the problem he "would then join with the majority in authorizing the field sequential system."

Commissioner Sterling also stated in his dissent that he believed the course of action recommended by him would have afforded additional benefits. In his view it would have given the Commission an opportunity to witness further demonstrations of the field sequential system on large size, tricolor tubes. The question of long-persistence phosphorus could also have been determined at that time. Finally, Commissioner Sterling believed that prior to adopting an incompatible system, with all its attendant problems, the Commission should have taken another look at a compatible system. He noted that although he had joined with the majority in the first report, and in the conclusion therein that no satisfactory compatible color system had at that time been developed, new developments had come fast during the closing days of the hearing and immediately thereafter, and that consequently he believed it would have been prudent to have taken time out to view such recent developments before finally adopting the field sequential system.

I trust that the foregoing will make clear the position taken by Commissioner Sterling in his dissent from the Commission action adopting the CBS field sequential system. I would greatly appreciate having this letter associated with the record of my testimony.

Let me take this opportunity, Mr. Chairman, to thank you and your committee for affording me the opportunity to present my statement on the Commission's role in the color-television matter to you the other day. If the Commission can render any further assistance to your committee in connection with this matter, we will be most pleased to do so.

Sincerely yours,

PAUL A. WALKER, *Chairman.*

Mr. HARRIS. Now, as I understand we have three systems under consideration, or maybe more.

Commissioner WALKER. At least two systems; yes, generally speaking two systems. The field sequential system. That is the system which the Commission adopted.

Mr. HARRIS The field sequential system?

Commissioner WALKER. The field sequential system.

Mr. HARRIS. And you have the compatible system?

Commissioner WALKER. And the compatible system.

Mr. HARRIS. Now, is the field sequential system the same as the so-called noncompatible system?

Commissioner WALKER. Well, it is a noncompatible system.

Mr. HARRIS. Yes; I understand.

Commissioner WALKER. I would not designate it as that particularly. I would designate it as a sequential system, and I say that it is noncompatible. It gives a complete picture, but you cannot get a picture in black and white on your ordinary receiver without an adapter.

Mr. HARRIS. Well, you mentioned one other word this morning with reference to one of the systems. I am sure that you used the words simultaneous system.

I am sure that you must have been referring to some of the same systems which have been discussed heretofore. Someone called it the dot system and someone the line system; and some the compatible system, and I was endeavoring to try to get those differences in my own mind in order that we could appropriately refer to them.

Now, we have had a lot of testimony presented to us about standards; standards for this system and standards for that system.

You have presented to us criteria. I assume the criteria you presented in your statement, at page 8, refer to consideration of any system; is that true?

Commissioner WALKER. Yes.

Mr. HARRIS. It would not apply to a compatible system any more than it would the field sequential system?

Commissioner WALKER. This is right.

Mr. HARRIS. And, consequently, they are all operating under the same criteria.

Commissioner WALKER. That is correct.

Mr. HARRIS. Now, the thing that is not clear to me is just what has been the result of the action of the Commission in adopting, as I understand, the field sequential system. Now by that, just what have you done? You say there has been nothing resulted from it; no broadcasting; there are no receiving sets; no manufacturing or anything toward it?

Commissioner WALKER. Well, unfortunately, or fortunately, the Commission's jurisdiction extends no further than prescribing the standards. It cannot compel anybody to build sets; it has no jurisdiction over set manufacturers.

Now, we should have preferred to have had a satisfactory compatible system presented to us. In fact, we had hoped that when the hearings came on that some of these statements that had been made, so optimistically by some of the companies, that a satisfactory compatible system is here, might prove to be true, but unfortunately we never saw a satisfactory compatible system demonstrated, though plenty of opportunity for such demonstration was given and we witnessed many, many, demonstrations.

On the other hand, the Columbia system—the sequential system—I refer to it as the Columbia system, because Columbia was the sponsor of it—the sequential system gave a complete picture.

I am talking about the hearings we had in 1949 through 1950. It gave a complete picture. It always had given a complete picture. It had for years given a satisfactory picture. It had been field tested to some extent and at the hearings we held, the last hearing we held in 1949 and 1950, evidence of the field testing was given.

So, with that system before us and no other satisfactory system, there was only one thing the Commission could do, in the judgment

of the majority of the Commission, and that was to adopt the field sequential system.

Mr. HARRIS. I appreciate that, and I personally, from the knowledge I have of it, am inclined to agree with the Commission's action, with the information and the development before it at the time. Certainly I agree with others that the compatible system would be desirable, and I hope that some day we may have it; but the point that I was trying to get responses to is just what has been the result of the Commission's action in adopting standards for the field sequential system.

Commissioner WALKER. Well, practically what you mean is whether sets have been manufactured.

Mr. HARRIS. That is the point.

Commissioner WALKER. In the field sequential system?

Mr. HARRIS. Yes.

Commissioner WALKER. Generally speaking they have not. The company which proposed the field sequential system was not at that time, generally speaking, in the manufacturing business. At that time, so far as I know, the company did not make receivers, television sets. It later did go into the manufacturing business, but by that time the conditions which have been recounted were experienced and among them this order of the production authority which has been referred to.

Mr. ROGERS. Will the gentleman yield?

Mr. HARRIS. Yes, very briefly.

Mr. ROGERS. Very briefly?

Mr. HARRIS. Yes.

Mr. ROGERS. You referred again to NPA Order M–90?

Commissioner WALKER. Yes.

Mr. ROGERS. Did you have any invitation to attend that hearing?

Commissioner WALKER. I beg your pardon.

Mr. ROGERS. Did you have any notice that they were going to have a hearing in connection with NPA Order M–90?

Commissioner WALKER. I did not say we did not know anything about it. I said we did not participate in it. We were advised of it just as other people were that the NPA was going to take the action.

Mr. ROGERS. If you had been heard, what would have been your position?

Commissioner WALKER. Well, now, I could not answer that without knowing what the evidence was; and I just do not know.

Mr. ROGERS. Did it seem to be a reasonable order for the NPA to put out at that particular time? If you had been called upon would you have objected personally to it?

Commissioner WALKER. If I had been there I probably would have suggested that I hoped that the Authority would not find it necessary to do that. We did not want it done; that is certain. But, as I said we are not an authority on materiel, and the defense situation and other matters of that sort. So, I prefer not to try to testify on that.

Mr. ROGERS. I think you said you did have notice?

Commissioner WALKER. Yes; we knew about it.

Mr. ROGERS. Why didn't you appear?

Commissioner WALKER. I do not know that we had any invitation to appear. We were kept advised about it. I do not know that there is any reason why we should have appeared and take a position about it. That is hardly our function down there.

Mr. ROGERS. That is all. Thank you, Mr. Harris.

Mr. HARRIS. Now, there is one other question I want to ask, Mr. Walker, and that is with reference to Dr. Baker's statement with reference to field testing.

Commissioner WALKER. Yes.

Mr. HARRIS. You said you had not had any regular order, had not issued any regular order regarding field testing?

Commissioner WALKER. Yes, sir.

Mr. HARRIS. You said that you did not say 15 minutes, or 30 minutes, or hours, or days. What did you say?

Commissioner WALKER. Well, I said whatever I read in my statement, which was a correct statement.

Mr. HARRIS. That is just what you said. I have no doubt that that is a correct statement, but you said you did not say 15 minutes; you did not say 30 minutes; you did not say hours, or days. Now, what is the policy?

Commissioner WALKER. The policy is, whatever is necessary.

Mr. HARRIS. In other words, if Dr. Baker and his group, or any of these groups, would present to the Commission information that a certain time is necessary for field testing, the Commission would take that under consideration?

Commissioner WALKER. We not only would take it under consideration, Mr. Harris, but we would most likely grant it.

Mr. HARRIS. And that is usually the proceeding the Commission operates under not only on color television, but other matters in the past?

Commissioner WALKER. I might interject this, however. Immediately following our adoption of the field sequential system, any throwing wide open of testing of other systems would, as a practical matter, have discouraged the manufacture and introduction of the system which we had adopted, because if the manufacturers and the public knew we were not sure of ourselves, that we were already testing out another system and advertising to the world that we were doing it, there would have been a general discouragement of the system which we had adopted.

So I think we had a moral obligation to the system which we had adopted to try to give it a fair test.

Mr. HARRIS. I agree with that, that you had not only a moral obligation, but you have an official obligation and a duty to the general public to see that these tests are met and any development in this field is properly considered.

Now, when someone comes to you and asks say for 30 minutes or an hour for field testing, how long does it take in the proceedings to get a response or a reply?

Commissioner WALKER. Well, a very short time; anywhere from 48 hours to a week. I would say if a request came which happens to be a matter which has to have the Commission's formal action on it, it would be done within a week. A lot of these matters we have delegated to the staff and it would not be longer than 48 hours.

Mr. HARRIS. Thank you. That is all, Mr. Chairman.

I want again to thank the Chairman of the Commission for the very fine statement given here and I fully appreciate the responsibility that you and your fellow Commissioners have in connection with this problem.

Mr. O'HARA. Mr. Chairman.

The CHAIRMAN. Mr. O'Hara.

Mr. O'HARA. Mr. Walker, I want to join with my colleague, Mr. Harris, in saying to you that I appreciate the statement that you have made here this morning; that I appreciate the complexity and problems which the Commission has in times past, and that it still has others with greater or less complexity.

It is quite obvious, is it not, Mr. Walker, that the adoption by the Commission of the sequential system was not accepted by the industry generally as the answer to the problem. In the light of what has transpired that is a correct statement, is it not?

Commissioner WALKER. That is a correct statement, I think.

Mr. O'HARA. And that we do have the situation today where color television is not advanced—not that the decision of the Commission was not the only one you could make at that time, but it probably was the only decision that the Commission could make at that time. But, in the light of subsequent developments it now appears that that system is not acceptable and that there will not be development of color television under that system. Is that correct?

Commissioner WALKER. Yes, Mr. O'Hara, it is obvious that if nobody manufactures sets, the public cannot get an opportunity to buy them, and that is the situation at the present time.

Mr. O'HARA. Now, I would assume that the Commission would certainly be anxious to approach the problem in the light of what has developed since then as soon as there is before the Commission any system which is more acceptable, more adaptable, in the light of scientific development. Is that not true?

Commissioner WALKER. That is true. The only thing that we are anxious about is that—waving aside the system—it is immaterial to us what system is developed, so that it gives results. But, while we want a compatible system and hope to have a compatible system, we also would like to find a system which gives a satisfactory picture. Without that the broadcasting of color is of no avail.

Mr. O'HARA. Would it be a fair statement, Mr. Walker, in response to the question—if you can and care to answer it—that the Commission will act promptly and will not need to have as long hearings as it had before, because certain things have been developed in previous hearings which will not have to be gone over at that time. Is that true?

Commissioner WALKER. I am quite sure that it will not be necessary for any extensive hearings, such as we had before, because a large portion of the time of that hearing was taken up with testimony and demonstrations, and inquiries into the patent situation and so on and so on. I hope that we will not have to go into those collateral matters in a new hearing. If somebody were to invent and to demonstrate at once a satisfactory compatible system, I think it would take a very short time, so far as hearings are concerned and so far as we are concerned, to settle the matter before the Commission.

Mr. O'HARA. Now, in any hearing which would be called—the reason I bring this up is that there has been suggested by one witness, that that would necessarily be an informal one—with that I might not be in accord, and the Commission might not be in accord. But, what is your feeling as to any further hearings on the determination of a

new system? Would you want that to be formal, and due notice be given to the various interests? Is that right?

Commissioner WALKER. You would be obliged to give due notice to everybody. You would be obliged to hear a certain amount of testimony. You would be obliged to give due process to everybody.

Now, that does not mean that the hearing would have to drag out for 6 months; 3 months; or even 2 months. It could be a reasonably short hearing.

And I would hope with the committee, the NTSC Committee working on it, that the industry itself might come before the Commission with some agreement on the system.

Mr. O'HARA. May I say to you, Mr. Walker, I doubt that. The stakes are too high.

Commissioner WALKER. Well, that is quite true. That is true, but that is one of the questions you have got to know before you can answer about how long the hearing will take.

Mr. O'HARA. Just as a country boy, I say that.

Commissioner WALKER. Well, as a country boy, I think you are correct.

Mr. O'HARA. Mr. Walker, I was impressed greatly by Dr. Baker's statement—and Mr. Harris has asked you with reference to some of it—in which I think if justifiabel is a serious complaint, and that is as to the limitations in existence—at least I gathered that impression. It might not be a fair one. But, I gathered from Dr. Baker's testimony that limitations have been imposed on this experimental work of testing of color television.

Now, I want to put this question to you. Has the Commission denied—and I realize there are a number of competing interests—has the Commission denied any extensive request for more broadcasting of color television, which I assume is highly important in connection with these field tests? Now, what has the Commission done in regard to that? Has it been parsimonious in the time it has granted, or have you given them whatever they have asked for?

Commissioner WALKER. We have not been parsimonious. The Chief of the Broadcasting Bureau tells me that almost all applications which have been made for time to broadcast have been granted. I think that there have been only three denials, and the number of requests must have run into dozens and dozens.

Mr. O'HARA. Well, I notice that there have been some requests granted in 1953. I think there are not so many of them. I notice that there are probably 3 or 4.

Commissioner WALKER. There have been probably 3 or 4. There are probably others here who are more familiar with that than I.

Mr. O'HARA. Were those all of the requests that were made or were there some turned down completely?

Commissioner WALKER. These were all that were made. None were turned down.

Mr. O'HARA. None were turned down?

Commissioner WALKER. Except the three, all of the rest have been granted, I am advised.

Mr. O'HARA. Have you cut them down, where they have asked for an hour, given them 30 minutes, or where they asked for 30 minutes, given them 15 minutes?

Commissioner WALKER. My answer would be both as to the time and the requests itself.

Mr. O'HARA. Thank you, Mr. Walker, that is all.

Mr. ROGERS. Just one question, Mr. Chairman.

The CHAIRMAN. Mr. Rogers.

Mr. ROGERS. Now, first, Mr. Walker, I want to share the expressions made by my colleague, Mr. Harris, concerning the statement that you have made. You have certainly made a fine statement.

Commissioner WALKER. Thank you, sir.

Mr. ROGERS. And I want to ask you first, I understood you to say that the field sequential system is more economical than the compatible system?

Commissioner WALKER. I do not think I made a statement on that.

Mr. ROGERS. What is your observation on that, if you can make one?

Commissioner WALKER. As to the expense?

Mr. ROGERS. Yes.

Commissioner WALKER. Well, if you could get a receiver which was a compatible receiver and which would receive both color and black and white, that would be less expensive than a system which required adaptors.

Let me say, you are getting into an engineering subject and I would prefer that you ask our engineer, Mr. Plummer, to give his opinion about that.

Mr. ROGERS. I would like to have your opinion, presuming that there is a compatible system that can be put into effect—and, of course, you know that the consequential system can, because you have adopted that.

Now, which would be the more economical? What system would be the more economical to get color television developed?

Commissioner WALKER. The one we have adopted, the sequential system, if you are just trying to get color; if you wanted to buy a color machine, it would be the system that would be less expensive, cost less money.

Mr. ROGERS. That is the field sequential?

Commissioner WALKER. The field sequential. That is what I am advised.

Mr. ROGERS. Well, now I notice that—and I want to commend you for this criteria you set out here trying to take care of the ordinary users, the public. That is one of the criteria. In other words, you set out that "It must be capable of operating through apparatus at the station that is technically within the competence of the type of trained personnel hired by a station owner who does not have an extensive research or engineering staff at his disposal and the costs of the purchase, operation, and maintenance of such equipment must not be so high as unduly to restrict to the class of perosns who can afford to operate a television station."

That is one of the criteria?

Commissioner WALKER. That is correct.

Mr. ROGERS. Now, I just want to congratulate the Commission in in trying to take care of the public.

Commissioner WALKER. Thank you.

Mr. ROGERS. That is all, Mr. Chairman.

Mr. HALE. Mr. Chairman.

The CHAIRMAN. Mr. Hale.

Mr. HALE. Mr. Walker, do you know anything about the origin of this order M-90?

Commissioner WALKER. No.

Mr. HALE. Who first conceived the idea of it and why?

Commissioner WALKER. No; I do not have any information on that. As I say, it was not our order and was not anything that we had anything to do with.

Mr. HALE. Is it an order which you are in sympathy with?

Commissioner WALKER. As I said, if I had been asked about it I would have advised against it; but in doing that I would have been advising without knowing what the materiel situation was and consequently my advice would have been of little value.

I would have hoped that it would not be issued. I would have advised against it, if I had been asked about it; but as I said, I do not know what the materiel situation was and therefore my advice might not have been of very great value. My advice would have been because I would have wanted to see this set manufacturing, color television go on.

Mr. HALE. I suppose even as of today you would not want to take a position as to the materiel situation, which was the presumed motivation for the order?

Commissioner WALKER. That is right. That is in the hands of the Production Authority, and that is something we do not have jurisdiction over.

Mr. HALE. That is all.

The CHAIRMAN. Mr. Mack, or Mr. Thornberry, do you have any questions?

Mr. MACK. No, Mr. Chairman.

Mr. THORNBERRY. I believe not.

Mr. HESELTON. Mr. Chairman.

The CHAIRMAN. Mr. Heselton.

Mr. HESELTON. Has your legal staff had an opportunity to study this memorandum of law on the power of the Federal Communications Commission to authorize immediate broadcasting of compatible television issued by RCA?

Commissioner WALKER. Yes.

Mr. HESELTON. Have they reached any conclusion on it?

Commissioner WALKER. The staff has studied the matter. It has not yet discussed the matter with the Commission.

Mr. HESELTON. Do they intend to do so?

Commissioner WALKER. Yes.

Mr. HESELTON. I suppose that the public's attention will be called to whatever determination is reached; but I suggest that in terms of the record, copies of the opinion might well be filed with the committee, when that is given.

Commissioner WALKER. We have no formal proceeding on it. Nobody has made any request to file any petition. But, as I said, the staff has had an opportunity to study the matter and will advise with the Commission.

Mr. HESELTON. Well, of course, it was filed with the committee, and I assumed for a serious purpose, and therefore I understand it was

brought to the attention of the Commission. Is some particular proceeding necessary for them to present it?

Commissioner WALKER. No. If this committee asks for an opinion of the Commission on the matter, the Commission will be glad to give it.

Mr. HESELTON. What is your suggestion, Mr. Chairman.

The CHAIRMAN. I beg your pardon.

Mr. HESELTON. What is your judgment on that?

The CHAIRMAN. I did not hear you.

Mr. HESELTON. He says if the committee asks for a memorandum on it, that they will be glad to file it.

Commissioner WALKER. I might say this, Congressman, that if we are asked for an opinion, we have this document but the RCA has not asked for our opinion on it.

Mr. HESELTON. I am not sitting here representing the RCA.

Commissioner WALKER. I understand you are not; but we do not have any request for an opinion. That is what I am telling you.

Mr. HESELTON. Well, I will give that later consideration.

Commissioner WALKER. If the committee will let me say this to you, if the committee wants an answer we will give it.

Mr. HESELTON. I asked Dr. Baker 2 or 3 questions. I would like to ask you, for the record, the same questions.

Are the standards adopted by the Federal Communications Commission for black and white television tied to the patents of any particular company in the sense that the manufacturer of broadcasting equipment or receiving sets have to pay royalties to that particular company?

Commissioner WALKER. So far as I know, somebody who is not an owner of a patent, always pays royalties to somebody else, and I am quite sure that in licensing its patents to others that RCA collects royalties. Now, I am not saying that that royalty is exorbitant. I cannot answer that question.

Mr. HESELTON. What was the patent situation in this regard with respect to the field sequential system adopted by the FCC?

Commissioner WALKER. Well, the patents would be Columbia System's, I presume. I do not know.

Our General Counsel advises me that there is a report in our file which will give an answer to the situation and we will be glad to furnish that to the committee, if the committee desires.

Mr. HESELTON. Then, the final question would be: What would be the patent situation in that regard if the FCC should adopt the standards proposed by the National Television System Committee?

Commissioner Walker. Well, I would not know until we got the application. Now, as to the National Television System Committee, if that is the recommendation of all of the industry, who would patent it, I do not know. I assume that it probably would be patented.

Mr. HESELTON. May I ask you this question—from Dr. Baker's statement, the impression I received was that there was not very close cooperation on the part of the Commission in connection with the field tests that may be desired.

Does the Commission follow as closely as it feels desirable the development of these field tests?

Commissioner WALKER. Yes.

Mr. HESELTON. Would there be any possibility of closer cooperation that might cut down the time element of making color television available?

Commissioner WALKER. I would say that in view of the present situation that nobody is undertaking to manufacture the field sequential system equipment, you have a different picture.

Mr. HESELTON. What was the last?

Commissioner WALKER. I would say that in the light of the present situation with nobody attempting to manufacture or sell the field sequential system equipment that we have a different situation than we had when we promulgated our report and that the Commission could give a greater degree of assistance, if you wan to put it that way, to those who are attempting now to develop and get on the market a compatible system.

I think that the Commission had a moral obligation to the Columbia Broadcasting System to see that the system which the Commission adopted on the representation of the Columbia Broadcasting System had a chance. In other words, the Commission would not want today to adopt the field sequential system and tomorrow begin testing another system and publicly announcing the results of such tests.

Mr. HESELTON. I understand that thoroughly. I agree with your position. What I am trying to get at is in view of the varied statements of time which have been given to this committee; in view of your own statements; and in view of Dr. Baker's statement; is it fair to say that we can assume now under these existing conditions that the Commission sees an opportunity to speed up the field tests or at least follow them closely enough so that that will probably bring down the time?

Commissioner WALKER. Well, we will give every cooperation. The arrangements that we have at the present I think will take care of the situation.

Mr. HESELTON. That is all, Mr. Chairman.

Mr. YOUNGER. Mr. Chairman.

The CHAIRMAN. Mr. Younger.

Mr. YOUNGER. Mr. Walker, I want to pursue one question here. You made the statement that the Commission has the authority only to adopt standards?

Commissioner WALKER. Yes.

Mr. YOUNGER. In other words, your function is to adopt a standard; a standard signal, so as to make it uniform. That is the function of your Commission?

Commissioner WALKER. That is right.

Mr. YOUNGER. And it follows that that is the sole function of your Commission, to make uniform the signals?

Commissioner WALKER. Well, I would not adopt the word "sole." But, that is the function of the Commission and a proper function of the Commission.

Mr. YOUNGER. All right. Then, this is what I would like to know. Why do you bring economics into it? For instance, when you say—I am quoting from page 7 of your statement:

> The Commission is of the firm opinion that it would not be in the public interest to establish a television system where only black-and-white receivers are cheap enough for the great mass of the American people and color television is available to those who can afford to pay luxury prices.

Now, you are weaving into your decision economics and the theory of economics and I am wondering if that is a part of the law.

At one time you say one thing and at another time you say another.

Commissioner WALKER. I think I am quite consistent, Mr. Younger.

You cannot upset the economic laws of the country and I do not care what you do. So, you have got to recognize it. You have got to recognize those laws and you have got to, when you are putting sets on the market, make those sets available to the public at large.

I think it would be very, very, unfortunate if the Commission were to adopt some other system.

Mr. YOUNGER. Well, what figure was given to you as to the cost of a receiver at the time you adopted the field sequential system?

Commissioner WALKER. Let me get the record on that. I am reading from page 43 of our report:

> According to testimony of manufacturers called as CBS witnesses, a new combination black-and-white and CBS disk-type color receivers could be sold at a retail price of approximately $200 for a 7-inch tube magnified to 10 inches, and approximately $300 for a 10-inch tube magnified to 12½ inches. Du Mont testified that a new combination black-and-white and CBS disk receiver, using a 12-inch tube (without magnification) could sell for $500 to $600, based on an annual production of 100,000 compared to $329 for a Du Mont black-and-white set of similar quality.

Again, an RCA witness testified that a 10-inch disk——

Mr. YOUNGER. They were not testifying on that. I am talking now about the field sequential system. Let us forget all of the rest.

Commissioner WALKER. All right.

Mr. YOUNGER. On the field sequential system you say that the CBS testified that they could produce a receiver for $200?

Commissioner WALKER. Approximately $200.

Mr. YOUNGER. All right. How many sets did they ever make?

Commissioner WALKER. We do not have any information on that. They did not manufacture very many, because they did not have any manufacturing——

Mr. YOUNGER. There were sets on sale, were there not?

Commissioner WALKER. Yes; there were some sets on sale.

Mr. YOUNGER. All right. At what price were they on sale to the public?

Commissioner WALKER. I do not have the information. Does anybody here know?

Mr. YOUNGER. Well, as I recall——

Commissioner WALKER. I am advised that Dr. Du Mont's testimony dealt with that.

Mr. YOUNGER. As I recall—what I am trying to get at is, the testimony we have had in the committee was that the sets were on sale at approximately $600.

Commissioner WALKER. I just do not know, Mr. Younger, what they sold for.

Mr. YOUNGER. Well, I am trying to weave this fact into your theory that you would not approve anything unless it could be sold cheap enough for the great mass of the American people, and you go into the economy of these things, yet there is nothing to back it up.

Now, I can see, so far as the technical standards that you set are concerned, you have authority, but when you come into the manufacturing and start to set standards of manufacture, that is something else. Your own testimony is that that is outside of your field.

Commissioner WALKER. You are quite right about that; but let me suggest this, if you set standards for a system which the industry itself will not adopt and will not manufacture sets for, of course, you are not going to get sets manufactured at anything like a reasonable price.

Mr. YOUNGER. That is exactly what you did, did you not?

Commissioner WALKER. We adopted a system which was the only system that would give a picture.

Mr. YOUNGER. Wait a minute. Let us go back to your statement.

Commissioner WALKER. All right; let me answer. We adopted a system which was the only system which would give satisfactory service.

Mr. YOUNGER. All right.

Commissioner WALKER. No, if the manufacturers had accepted that system and had started to manufacture sets, the price would have gone down just as sets on black and white have gone down; the price of those sets would have gone down.

Mr. YOUNGER. Now, that is just what I wanted you to admit.

Commissioner WALKER. No; I am not making any admission. I am just telling you the facts.

Mr. YOUNGER. You said that if a company manufactured the sets that actually when they got into production, the price of the sets would go down.

Commissioner WALKER. Yes, that has always been true.

Mr. YOUNGER. All right. Then why is the attitude of the Commission to start in with this kind of a philosophy? That is the point that I am trying to get at. You do not back it up now with your own testimony. I do not think that the Commission ever had it in view. If they did think it, they were outside of their own sphere when they went into the economies of this thing and say that was what they intended to when they set the standards, because you will admit that you set a standard which the producers would not accept and did not produce under.

Commissioner WALKER. Which the manufacturers did not adopt and did not manufacture under.

Mr. YOUNGER. That is right. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Walker, here is what I would like to know in all of this maze of charges and countercharges: What do you suggest we do as a committee or an industry, or as your Commission, to bring about at the earliest possible day a settlement of this question of color television?

Commissioner WALKER. I wish I knew, Mr. Chairman. I wish I knew what we could do.

The minute that anybody presents to us, in the light of the history of the last 3 years, anytime anybody presents to us evidence of a satisfactory compatible color system, we will be ready to hold a hearing promptly and to get the machinery going to get an adoption of such system and get it going and give the manufacturers an opportunity to make sets and get them into the hands of the public. I do not know any way of doing it.

The CHAIRMAN. Does your answer contemplate that the Commission can, on its own initiative, institute such a hearing in the public interest, or would it require some interested party to make such an application?

Commissioner WALKER. We could set a hearing; but we probably would not set a hearing in the absence of knowledge of some development which would justify such a hearing.

The CHAIRMAN. I have in mind this situation, if I may just address a question or two to you:

During the testimony of Mr. Stanton, at page 172 of the transcript, in answer to a question he said:

> At this stage of television development, if the system, if the compatible system, gives a good clear picture at a reasonable price to the public, there is no question but what at this stage of the art and development we would be better off from a broadcasting viewpoint with the compatible system.

Now, having that statement in mind, how can we determine whether there is a satisfactory compatible system now available? I understood you to say in your testimony that you had not, or the Commission had not, at any time seen any demonstration of a satisfactory compatible system.

Commissioner WALKER. That is correct, Mr. Chairman.

The CHAIRMAN. When was the last viewing of a demonstration that the Commission had on the basis on which you say there has been none demonstrated to you?

Commissioner WALKER. Well, I do not recall that we have had demonstrations since our hearings, when we adopted the field sequential system, and as I recall Dr. Baker's testimony, the manufacturers generally will not be ready to present any evidence on a satisfactory system to the Commission for some months, and until they have had an opportunity to field test the system which they are now working on.

Now, nobody else has come to the Commission with any evidence of a satisfactory color system and consequently at the moment we do not have anything before us to bring about the advisability of an immediate hearing.

I think that a hearing to find out what is being done would not be of any avail. I think you have gotten the testimony here from the manufacturers themselves which tells you what the situation is so far as the manufacturers are concerned.

The CHAIRMAN. Let me see if I get this correct. Then, the Commission has had no demonstration, nor seen any demonstration, of a compatible system since its original decision in 1950 at which time it adopted the field sequential system?

Commissioner WALKER. Of a satisfactory compatible system, Mr. Chairman.

The CHAIRMAN. Have you had any demonstration, or seen any demonstration, satisfactory or otherwise? In other words, I am trying to find out whether the Commission has had any demonstration or not.

Commissioner WALKER. Not before the Commission. Mr. Chairman, the Commission has its engineers and its staff members constantly in touch with these tests that are being made from time to time by the NTSC, and by manufacturers.

The CHAIRMAN. Is the Commission familiar with the present, what seems to be advanced stage of the compatible system?

Commissioner WALKER. The Commission has kept advised; yes.

The CHAIRMAN. Has the information which you have received convinced the Commission that it would be appropriate for it in a formal hearing to consider the matter at this time?

Commissioner WALKER. No. It would not be advisable, in my opinion, to hold a hearing at this time. I think that Dr. Baker was correct in his advice that he gave to the committee that the development is not sufficiently far advanced to bring about any worthwhile results through a hearing at this time. I quite agree with Dr. Baker that an opportunity should be given for field testing the system which the NTSC claims would give a satisfactory compatible color picture and if anybody else, aside from NTSC has any development which he thinks would give a satisfactory color picture, then if we have a representation from him or from any others, we ought to hear the matter all at the same time.

I think it would be futile, Mr. Chairman, to conduct a hearing on what the NTSC is trying to do when apparently they are working in a sincere effort to try to develop something worthwhile to present to the Commission in an application for adoption of color television standards.

The CHAIRMAN. Very well. Then it would seem pretty generally agreed, if not unanimously agreed, that the time is not ripe for an immediate formal hearing which would adopt the standards other than what have already been adopted?

Commissioner WALKER. That is my opinion.

The CHAIRMAN. That leaves us then with the question before us as to what field testing you think there should be before there is any such hearing either held on the initiative of the Commission or by application of an interested party.

Commissioner WALKER. I think that probably the most satisfactory answer that I could give would be to insert into the record—I do not have a copy of the public notice here—the public notice which the Commission issued in reference to this matter and which would give the standards and details and procedures incident to a further hearing on color television. I should like to supply that for the record.

(The matter referred to is as follows:)

FEDERAL COMMUNICATIONS COMMISSION,
Washington 25, D. C., June 11, 1951.

FCC STATEMENT ON COLOR TELEVISION

The purpose of this public notice is to answer some of the recurring questions which have been asked of the Commission since May 28, 1951, the date upon which the United States Supreme Court upheld the validity of the Commission's order adopting the field sequential system of color television transmissions.

1. *When will color broadcasts begin?*—Color broadcasts on a commercial basis can begin when the Supreme Court issues its mandate. Under the rules of the Supreme Court the mandate issues 25 days after the opinion—June 23, 1951. The Commission will put out a public notice when the mandate is issued so that all interested persons may be advised of the date when color broadcasts can begin.

2. *Who can broadcast in color?*—All regular television stations are permitted to broadcast color programs in accordance with the standards adopted by the Commission. The authorization to broadcast regular monochrome television programs carriers with it automatically permission to broadcast such color programs. Experimental television stations may broadcast color programs only if authorized by the Commission as a part of their programs of technical experimentation.

3. *How much color broadcasting is permitted?*—Under the Commission's rules a regular television station may broadcast as many color programs as it desires and it may broadcast such programs at any time of the day or night that it desires.

4. *Can color programs be sponsored?*—Color programs which are broadcast in accordance with the field sequential system authorized by the Commission can

be sponsored or not sponsored in exactly the same manner as monochrome programs.

5. *Is it permissible to broadcast color programs in accordance with a system other than the one approved by the Commission?*—Only one color system, the field sequential system, has been approved by the Commission for regular broadcasting. Other color systems proposed to the Commission were found unsatisfactory by the Commission. The Commission, however, does encourage experimentation in the entire radio field. Persons with genuine programs of experimentation in the color field may carry on their experiments by securing experimental authorizations upon appropriate applications to the Commission. Such authorizations, however, do not permit the rendition of a regular broadcast program service nor may any of the programs be sponsored. It should be emphasized that the purpose of the experimental authorizations is to further a genuine program of experimentation.

6. *Is there any possibility of a different color system being adopted in the near future?*—Before the Commission issued its final report in the color proceedings, it gave very careful consideration to all systems that were presented to it. The Commission concluded that the field sequential system was a satisfactory color system, whereas the other systems were unsatisfactory. That this determination was not arrived at hastily is evident from the fact that the hearing on color was conducted over an 8-month period during which time 53 witnesses were heard, 265 exhibits were offered, almost 10,000 pages of testimony were covered, and 8 different demonstrations were held on the record. Based upon this careful study the Commission came to the conclusion that only one color system, the field sequential system, met all the criteria for a satisfactory color television system. That is the system which the Commission has adopted.

The Commission, however, did not close the door to further experimentation. In a field as relatively new as radio in general and television in particular, there is always room for genuine programs of experimentation. The Commission is aware of the fact, as pointed out in its first report, that "one of the easiest methods of defeating an incompatible system is to keep on devising new compatible systems in the hope that each new one will mean a lengthy hearing so that eventually the mere passage of time overpowers the incompatible system by sheer weight of receivers in the hands of the public." In order to provide for experimentation while at the same time making it possible for color broadcasting by the field sequential system to develop and grow, the Commission has set forth a specific and detailed schedule which any new color system must meet. In outline, the steps are as follows:

(*a*) An appropriate petition must be filed requesting rulemaking proceedings with respect to color television standards.

(*b*) Representative receiver apparatus must be delivered to the Commission's laboratory at Laurel, Md.

(*c*) A signal must be put on the air in Washington, D. C., for the purpose of demonstrating the system.

(*d*) The above tests must show to the Commission's satisfaction that the proposed system has a reasonable prospect of satisfying all of the criteria for a color television system set forth in the reports. These criteria are as follows:

1. It must be capable of operating within a 6-megacycle channel allocation structure.

2. It must be capable of producing a color picture which has a high quality of color fidelity, has adequate apparent definition, has good picture texture, and is not marred by such defects as misregistration, line crawl, jitter, or unduly prominent dot or other structure.

3. The color picture must be sufficiently bright so as to permit an adequate contrast range and so as to be capable of being viewed under normal home conditions without objectionable flicker.

4. It must be capable of operating through receiver apparatus that is simple to operate in the home, does not have critical registration or color controls, and is cheap enough in price to be available to the great mass of the American purchasing public.

5. It must be capable of operating through apparatus at the station that is technically within the competence of the type of trained personnel hired by a station owner who does not have an extensive research or engineering staff at his disposal and the costs of purchase, operation, and maintenance of such equipment must not be so high as unduly to restrict the class of persons who can afford to operate a television station.

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6. It must not be unduly susceptible to interference as compared with the present monochrome system.

7. It must be capable of transmitting color programs over intercity relay facilities presently in existence or which may be developed in the foreseeable future.

If all of the above steps are satisfied by the proponent of a new system, the Commission would then order a hearing for the purpose of considering the petition. In accordance with established procedure, the ordering of a hearing would not have the effect of canceling the Commission's order establishing color standards. The field sequential system is the approved method of broadcasting in color and will continue to be so unless it is changed by specific order of the Commission.

The CHAIRMAN. Well, from the testimony of those who have preceded you, it would seem as if there was a feeling that the time had arrived for definite field testing.

Commissioner WALKER. Yes; I quite agree with that.

The CHAIRMAN. Very well. What can the Commission do in that state of the situation to make possible an early hearing? I am not speaking about shortcuts that you refer to in your statement, except from a timesaving standpoint, that is wherein the results can be worth while.

Commissioner WALKER. Well, there is nothing the Commission can do to force manufacturing or the development of a system and I think if we were to order field tests before the manufacturers were ready for it instead of speeding up color television that we would be retarding it.

The CHAIRMAN. Would it then seem that the orderly procedure would be for the NTSC, or any other group, to make an application for field tests upon such basis as they think would be most desirable to get the best possible results?

Commissioner WALKER. That would be the natural and logical way to proceed.

I would say that if we knew from any source of information that there were available or that there is a system, which is sufficiently developed for field testing, that we would order—that we would encourage, the field testing and then order a hearing at once.

The CHAIRMAN. I understood you to say that the Commission had kept advised of the advances that have been made and are under way by the NTSC so that it is fairly familiar with the present status of their cooperative efforts. If such is the case, are you not in a position to decide as well as they that there should be tests?

Commissioner WALKER. Yes. When I said what I did about any other system, you never know who is going to invent something and consequently that is what I referred to about the NTSC or anybody else. The NTSC, as I understand, is getting ready to go ahead with field tests, and we are cooperating in every way we can.

Now, if we are to order field testing before NTSC has completed its work and we were to get a premature system, why, I think we would be faced with the same opposition from the manufacturers that we were with the system we adopted. The manufacturers were not ready.

The CHAIRMAN. I agree with you as to that, unless you are convinced by your knowledge of the progress that has been made that the time has arrived when there should be tests, and not permit a delay, having in mind that your interest is the public interest.

Commissioner WALKER. I assure you that we will not permit a delay when we have any evidence, satisfactory evidence, that the system has gone far enough in its development, any system, has gone far enough in its development for field tests.

The CHAIRMAN. Did the testimony of Dr. Baker, on behalf of the NTSC, indicate to you that, in their opinion, they had reached a point where field tests would be appropriate?

Commissioner WALKER. Well, he stated positively that field testing would be necessary.

Now, we are ready to permit field testing if we have to permit it. There is no reason they cannot go ahead and field test, with their field testing any minute.

The CHAIRMAN. Except so far as he made suggestions of additional authority that could be given by the Commission that would be helpful in making tests. He made several suggestions. Is it the Commission's feeling that they should or should not be granted; or would that require a formal hearing?

Commissioner WALKER. No; it would not require a formal hearing. When he makes any requests to the Commission for the granting of permission for field tests, I am quite sure it will be granted.

Mr. Plummer, the Chief of our Broadcasting Bureau, tells me that there are applications for such tests now and that they are being granted and that the Commission staff will be cooperative.

There are listed here a number of field tests, where the tests of the RCA color system—I am reading from a memorandum that lists the applications.

Further tests of the RCA color system employing the revised NTSC specifications. Authority requested for 30 minutes of operation daily between 9 a. m., and 1 p. m., on weekdays, from March 2 to 31, 1953. Authority granted for same period without limiting it to weekdays.

The CHAIRMAN. What was the date of that grant?

Commissioner WALKER. That grant was on April 2—it could not be April 2.

The CHAIRMAN. We do not want to get ahead too fast.

Commissioner WALKER. It is a grant from April 2, 1953, to June 1, 1953—I was correct in the first place. They asked for advance authority, which we granted to field test from April 2, 1953, to April 30, 1953.

The CHAIRMAN. In the making of those field tests, will the Commission, through its engineers, be represented?

Commissioner WALKER. That is correct; it will be.

The CHAIRMAN. Will that facilitate the Commission's passing on the adaptability of this?

Commissioner WALKER. It will speed up matters. If they have a satisfactory field test the Commission will be advised.

The CHAIRMAN. If there are any other requirements necessary to be made in order to facilitate the tests to the end that there may be an early decision, in your opinion, would the Commission be willing to make such orders?

Commissioner WALKER. The Commission certainly would. The Commission wants to cooperate in every way it can to speed up color television.

The CHAIRMAN. Do you have in mind that at the moment there is any additional authority that should be given you, or restriction that

should be removed on the authority given to you, to the end that these tests may be as fully and helpful as it is possible for them to be?

Commissioner WALKER. Well no, I do not have in mind any such additional authority. I would say this that any application they make within reason, these folks who want field tests, will be granted. That is our policy, to cooperate.

The CHAIRMAN. Is there any other industry group that you have knowledge of that is working upon this matter in the same way the NTSC is? In other words, I am trying to find out, as the result of remarks that you made during your statement, whether there are any conflicting groups?

Commissioner WALKER. I know of no conflicting group. A number of these manufacturers have their own tests. I assume that probably they have laboratory tests going on, but I think they are all cooperating—that is, RCA, General Electric, and all of the others, who are in the manufacturing business, are all cooperating through the NTSC, or the National Television Standards Committee.

The CHAIRMAN. Would you care to suggest any time as to the length of tests that would be necessary to determine whether the present suggestions of NTSC are satisfactory or not, before you would be able to pass upon the question?

Commissioner WALKER. No, the schedule which has been suggested by the NTSC and which is being carried out, seems not unreasonable. We do not have any evidence before us that the industry is trying to delay matters by the field tests, and we do know that it is necessary to give a reasonable time for the testing and I would think that the requests which have been made were within reason.

The CHAIRMAN. In the event that the tests should prove a definite advisability as to the adoption of that particular system as a basic one, how long, in your opinion, would it take for action to be taken by the Commission that would be a go-ahead signal?

Commissioner WALKER. Well, it would take very little time to get the authority to manufacture sets once the Commission knew that it had a satisfactory system. The field testing will indicate whether the system is satisfactory, and it is pretty difficult without the result of the field tests to say what the Commission could do, we have been disappointed so many times on representations which have been made to the Commission.

The CHAIRMAN. With the knowledge that you have as to the work that has been done in the 2 years intervening since your order was made; work that has been done by the NTSC, do you call that disappointing to you at the present time?

Commissioner WALKER. No. What I meant is that on the demonstrations we have had, after we have been advised that this manufacturer or that manufacturer had a satisfactory color system developed, when the evidence was taken, the evidence showed that there was not a satisfactory color system developed and that is what I meant.

The CHAIRMAN. But, in my supposition question or supplementary question, I have based that up on the satisfactory proof as a result of tests, and we are up to the point now as to whether if that were true, would it take any considerable time for the Commission to make it possible for the industry to proceed?

Commissioner WALKER. No, it would not take any considerable time for the Commission to give the go sign, if we had proof of satisfactory field tests and other satisfactory television, color television.

The CHAIRMAN. Well that is all very gratifying.

The committee looks forward not only with interest, but with pleasure, to the opportunity it will have on the 14th and 15th of April of viewing these different systems, and having the tubes demonstrated to us in New York.

I do not know whether it is appropriate for me to say it to you, but I know it is appropriate so far as the committee is concerned, but if the Commission wishes to have its engineers present on any demonstration that is made for the benefit of this committee, they certainly will be welcome and are entitled to be present. I leave that to the Commission to determine.

Commissioner WALKER. I think, Mr. Chairman, we will be glad to accept your invitation.

(The following letter was later received from Mr. Walker:)

FEDERAL COMMUNICATIONS COMMISSION,
April 9, 1953.

Hon. CHARLES A. WOLVERTON,
Chairman, Committee on Interstate and Foreign Commerce,
House of Representatives,
Washington, D. C.

DEAR CONGRESSMAN WOLVERTON: At the close of my testimony before your committee, during the hearings on color television, I advised you that members of the Commission's staff would attend the color-television demonstrations which are to be held next week. This is to advise you that the Commission has designated the following members of the staff to attend those demonstrations:

Edward W. Allen, chief engineer
Benedict P. Cottone, general counsel
Representing the Chief of the Broadcast Bureau:
Cyril M. Braum, Chief, Television Facilities Division
Arthur Scheiner, Chief, Rules and Standards Division.

Sincerely yours,

PAUL A. WALKER.
Chairman.

The CHAIRMAN. Thank you. I want to commend the statement that you have made which has been so complete and full on its factual side.

I am hopeful that as a result of these hearings and with the cooperation that has always been apparent, that the Commission will sooner or later—and sooner than later—be enabled to give the benefit of color television to the public.

Commissioner WALKER. Thank you, Mr. Chairman. I hope that your hopes are fully justified.

The CHAIRMAN. Well, there is an old saying that hope springs eternal, and I have always been a very hopeful individual.

STATEMENT OF ROBERT L. WERNER, RADIO CORPORATION OF AMERICA

Mr. WERNER. On behalf of the RCA, we will be glad on the 14th and 15th to have the members of the Commission staff, as Chairman

Walker indicates, present at the demonstrations and in addition we will be very pleased if the members of the Commission themselves would accompany this committee, if the committee so desires.

The CHAIRMAN. Well, I would not expect them to make any answer about that at the present time. I think that is a matter that they can consider among themselves. I purposely refrained from putting them in that position.

Mr. WERNER. RCA is glad to extend the invitation.

The CHAIRMAN. The committee will stand adjourned.

(Thereupon at 12:32 p. m., the committee adjourned.)

(The following material was later inserted in the record:)

HOUSE OF REPRESENTATIVES,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D. C., July 30, 1953.

Hon. ROSEL H. HYDE,
Chairman, Federal Communications Commission,
Washington 25, D. C.

DEAR CHAIRMAN HYDE: The Committee on Interstate and Foreign Commerce has adopted unanimously a resolution authorizing and directing me as chairman of the committee to request the Federal Communications Commission to take prompt action with regard to the petition filed by the National Television Systems Committee concerning the adoption of the NTSC color system and standards.

As you will recall, the Committee on Interstate and Foreign Commerce held hearings on the status of color television on March 24, 25, 26, and 27, and attended demonstrations of different color television systems and equipment used in connection with such systems. The committee feels that its interest in the advancement and early adoption of effective color television standards has played a material part in encouraging the communications industry to speed up the work that remained to be done with respect to the development of a compatible color television system.

The committee appreciates that the Commission has been reluctant to rush into new color television proceedings after having spent many years of hard work in previous color television proceedings which led up to the adoption of an incompatible system of color television. Now, however, that a unified approach has been made by the communications industry in which the leading technicians of that industry have participated and which has resulted in general agreement, the committee can conceive of no reason why the Commission should not proceed with utmost promptness to the consideration of the proposed new standards with a view to making color television a reality in the homes of the American people at the earliest possible date.

Sincerely yours,

CHARLES A. WOLVERTON, *Chairman.*

FEDERAL COMMUNICATIONS COMMISSION,
Washington 25, D. C., August 7, 1953.

NEW NTSC COLOR TV PROPOSALS BASIS OF FCC RULEMAKING

The Commission today announced rulemaking looking toward the adoption of new rules for color television transmissions on the basis of petitions proposing the adoption of signal specifications advanced by the National Television System Committee (NTSC).

Comments from interested parties will be received on or before September 8, 1953, and replies within 15 days thereafter. The recent petitions of the Radio Corp. of America and National Broadcasting Co.; NTSC; Philco Corp.; Sylvania Electric Products, Inc.; General Electric Co.; and Motorola, Inc., which all urge adoption of the NTSC signal specifications, are incorporated as comments in this proceeding.

The present rules for color TV transmission were adopted by the Commission on October 10, 1950. However, color TV broadcast equipment for the field sequential system is not now being produced, nor are color broadcasts in accordance with the present color rules being televised or contemplated.

The field sequential system adopted in 1950 is "incompatible" in the sense that black-and-white sets existing at that time could not receive color transmissions in monochrome without adaptation. While adopting this system, the Commission stated in its color report that if a satisfactory compatible color system had been available at that time it would have been desirable to adopt it.

When the Commission adopted the 1950 color rules, it recognized and provided for consideration of further experimentation and research in this field and, on June 11, 1951, specified the steps that would be required of the proponents of new color systems.

In 1950 the Radio-Television Manufacturers Association directed the NTSC to conduct necessary studies and experimentations to develop new and compatible color TV signal specifications. The NTSC is a voluntary association of engineers and scientists interested in the advancement of TV, and its members include representatives of the petitioners as well as many of the companies engaged in the manufacture of TV equipment. The Commission has been kept advised of the progress of NTSC in this field by means of various reports submitted to the Commission and by attendance at demonstrations. Numerous authorizations for on-the-air experimentation have been granted.

The petitioners now formally propose adoption of new rules for color TV. The Commission finds that they have taken the necessary steps for the institution of rulemaking.

BEFORE THE FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON 25, D. C.

Docket No. 10637

In the Matter of Amendment of the Commission's Rules Governing Color Television Transmissions

NOTICE OF PROPOSED RULEMAKING

1. The Commission has before it for consideration several petitions requesting the Commission to institute rulemaking proceedings looking toward the adoption of new signal specifications for commercial color television broadcasting in place of the present rules. Petitions were filed by the Radio Corporation of America, and the National Broadcasting Co., Inc., jointly, on June 25, 1953, amended July 22, 1953; the National Television System Committee on July 22, 1953; the Philco Corp., on July 23, 1953; Sylvania Electric Products, Inc., on July 24, 1953; the General Electric Co., on July 28, 1953; and Motorola, Inc., on July 30, 1953. All of the petitions propose the adoption of the signal specifications advanced by the National Television System Committee and which were formally adopted by that body on July 21, 1953.[1]

2. The Commission's present rules for color television transmissions were adopted on October 10, 1950, following the proceedings in Docket 8736 et al.; and the Commission's action was affirmed by the Supreme Court on May 28, 1951. On June 25, 1951, the Commission announced that television stations were permitted to broadcast color programs in accordance with the new rules. However, color television broadcast equipment for the field sequential system is not now being produced, nor are color broadcasts in accordance with the present color rules being televised or contemplated.

3. When the Commission adopted rules for color television in 1950, it recognized and provided for the consideration of further experimentation and research in the field of color television. In a public notice (FCC 51-592) of June 11, 1951, the Commission pointed out that "In a field as relatively new as radio in general and television in particular, there is always room for genuine programs of experimentation." In that notice the Commission stated, however, that in the interests of orderly procedure and stability, the following steps would be required of the proponents of new color systems:

(*a*) An appropriate petition must be filed requesting rulemaking proceedings with respect to color television standards.

(*b*) Representative receiver apparatus must be delivered to the Commission's laboratory at Laurel, Md.

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[1] The National Television System Committee is a voluntary association of engineers and scientists interested in development of television, and its members include representatives of the other petitioners as well as many of the companies engaged in the manufacture of television equipment.

(c) A signal must be put on the air in Washington, D. C., for the purpose of demonstrating the system.

(d) The above tests must show to the Commission's satisfaction that the proposed system has a reasonable prospect of satisfying all of the criteria for a color television system set forth in the reports. These criteria are as follows:

(1) It must be capable of operating within a 6-megacycle channel allocation structure.

(2) It must be capable of producing a color picture which has a high quality of color fidelity, has adequate apparent definition, has good picture texture, and is not marred by such defects as misregistration, line crawl, jitter or unduly prominent dot or other structure.

(3) The color picture must be sufficiently bright so as to permit an adequate contrast range and so as to be capable of being viewed under normal home conditions without objectionable flicker.

(4) It must be capable of operating through receiver apparatus that is simple to operate in the home, does not have critical registration or color controls, and is cheap enough in price to be available to the great mass of the American purchasing public.

(5) It must be capable of operating through apparatus at the station that is technically within the competence of the type of trained personnel hired by a station owner who does not have an extensive research or engineering staff at his disposal and the costs of purchase, operation, and maintenance of such equipment must not be so high as unduly to restrict the class of persons who can afford to operate a television station.

(6) It must not be unduly susceptible to interference as compared with the present monochrome system.

(7) It must be capable of transmitting color programs over intercity relay facilities presently in existence or which may be developed in the foreseeable future.

4. The field sequential system adopted by the Commission in its prior proceeding is "incompatible" in the sense that black and white sets existing at that time could not receive color transmissions in monochrome without adaptation. While adopting this system, the Commission stated in its color report that if a satisfactory compatible color system had been available at that time, it would certainly have been desirable to adopt it. In 1950 the board of directors of the Radio-Television Manufacturers Association directed the National Television System Committee to conduct necessary studies and experimentation to develop new and compatible color television signal specifications. The Commission has been kept advised of the progress of NTSC in this field by means of various reports submitted to the Commission and by attendance at demonstrations. Numerous authorizations for on-the-air experimentation have been granted.

5. The petitioners now request that the Commission institute rulemaking proceedings looking toward the adoption of new rules for color television. The question is presented whether petitioners have taken the necessary steps provided by the Commission for this purpose:

(a) The first requirement specified is the filing of a proper petition. This has been met by petitioners.

(b) The second requirement is the delivery of representative receiver apparatus to the Commission's laboratory at Laurel, Md. The NTSC represents that it will cooperate with the Commission in forwarding representative receiver apparatus to the Commission's laboratory at Laurel. All of the other petitioners, who are receiver manufacturers, have either already delivered such apparatus to the Laurel laboratory or have indicated their willingness and intent to do so.

(c) The third requirement is a signal on the air in Washington, D. C., for the purpose of demonstrating the system. None of the petitioners proposes to put a signal on the air in Washington at this time, either because they lack the facilities to do so or for other reasons; and waiver of this requirement is requested. NTSC does, however, express its intent to cooperate with the Commission in arranging demonstrations, and the other petitioners all indicate their willingness and intent to conduct and participate in demonstrations and tests. In light of petitioners' representations, our study and review of the signal specifications proposed, and our observation of various earlier demonstrations and field testing of the proposed signal specifications, we are of the view that it is not necessary that a signal be put on the air in Washington prior to the institution of rulemaking proceedings. The Commission will determine

at a later date whether during the course of the proceedings a signal on the air in Washington will be required.

(*d*) Finally, it is required that petitioners demonstrate to the Commission's satisfaction that the proposed system has a reasonable prospect of satisfying all of the criteria specified above for judging a proposed new color television system. Upon our review of all of the petitions and the data submitted therewith, our study and review of the proposed signal specifications, and our observation of earlier demonstrations and field tests, we are of the view that petitioners have made the required showing that the proposed system has a reasonable prospect of satisfying the listed criteria to the extent necessary for the institution of rulemaking proceedings.

6. In view of the foregoing, the Commission is of the view that rulemaking proceedings should be instituted looking toward the adoption of new rules for color television transmissions. Accordingly, notice is hereby given of proposed rulemaking in the above-entitled matter. The signal specifications for color television which petitioners propose that the Commission adopt are set out in the appendix attached hereto.

7. Any interested party who is of the view that the signal specifications proposed by petitioners should not be adopted, or should not be adopted in the form set out, may file with the Commission on or before September 8, 1953, written comments setting out data, views, and arguments. Written comments in support of the signal specifications as proposed may also be filed by the same date. Written comments in reply to the original comments may be filed within 15 days from the last day for filing the said original comments. An original and 25 copies of any written comments should be filed. The subject petitions of NTSC, Radio Corporation of America and National Broadcasting Co., Inc.; Philco Corp.; Sylvania Electric Products, Inc.; General Electric Co., and Motorola, Inc., are incorporated as comments in this proceeding.

8. Authority for the adoption of the standards as proposed is contained in section 303 (b), (e), and (g) of the Communications Act of 1934, as amended.

9. The Commission will specify in subsequent notices the time and nature of demonstrations and tests, and such further proceedings as may be necessary.

FEDERAL COMMUNICATIONS COMMISSION,
T. J. SLOWIE, *Secretary.*

Attachment:

Adopted: August 6, 1953.
Released: August 7, 1953.

[Press release, August 8, 1953]

STATEMENT BY HON. CHARLES A. WOLVERTON (REPUBLICAN, NEW JERSEY), CHAIRMAN

COLOR TELEVISION

It is very gratifying to me as chairman of the House Committee on Interstate and Foreign Commerce to learn that the Federal Communications Commission has today initiated rulemaking proceedings to fix new commercial color-television standards.

The Committee on Interstate and Foreign Commerce held hearings on the status of color television in March and April of 1953 and attended demonstrations of different color-television systems and equipment used in connection with such systems. The committee felt at that time that the compatible color-television system demonstrated to it had advanced sufficiently to warrant prompt action on the part of the Federal Communications Commission to assure the adoption of new and effective color-television standards.

I am pleased that now when a unified approach has been made by the communications industry in its application to the FCC, the Commission has seen fit to act with promptness.

I understand from the Commission's notice that interested parties will be given until September 8 to submit their comments. It is my hope that at that time the Commission will be able to dispense with further proceedings so that upon the adoption of the new standards color television will become a reality in the homes of the American people at an early date.

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